Electrical World

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The Pacific Coast Welcome

THE welcome of the Pacific Coast to the representatives of the industry attending the National Electric Light Association convention will be none the less cordial because it is an "off" year. The coast companies would have wished an occasion when brighter conditions prevailed, but they have much to show, and they have so deep an interest in the welfare of the industry that their preparations have been made with open-handed enthusiasm. The Eastern visitors will gain largely from the friendly spirit of the West, no less than from the study of Western practices. Certainly the readiness of the West to welcome the delegates will lead to a desire that the association shall have another convention on the Coast in some future year.

The California Installations

IN this issue of the ELECTRICAL WORLD there is given a complete survey of the remarkable California installations which delegates to the National Electric Light Association convention may inspect at first hand. Nature's lavish provision in waterfalls, the climatic conditions, the progress of the electrical art and the highly developed commercial utilization in a group of very prosperous communities combine to make the California properties conspicuous and creditable examples of that degree of efficiency which is the standing pride of the industry. It is not size alone that makes these properties notable, but their size is not to be ignored. The five companies for which statistical data are given have roughly one-tenth of the capitalization of the central stations of the whole country. The inevitable growth of population in the inviting California climate and the aggressive commercial policies and physical preparedness of the companies will produce the continued rapid development characteristic of such properties.

Public Policy

THE public policy of the National Electric Light Association has been consistently broad-minded. Year by year it has been based on the recognition of the fact that central-station companies have certain clearly defined obligations toward the public and that their prosperity and their hold on public good-will depend to a very large extent upon their attitude toward these acknowledged obligations. The public policy committee has stated the principles of conduct by which companies may develop the invaluable influences of public co-operation and support. That the committee expects to depart this year from its regular practice so as to discuss the other side of the story—what the public owes to the companies—gives unusual interest to its forthcoming report. All companies have not reached perfection in their public policy, and the necessity for impressing sound doctrines upon them has not passed; but the shortcomings are just as plain on one side as on the other. There is no reason why the companies should not state frankly where they see public mistakes. Their greatest responsibility, however, lies in following such a course that public mistakes shall be neither popular nor successful and fair public policies shall prevail.

The Central-Station Farmer

IT is stated in an article appearing elsewhere in this issue that the engineers and selling men who have been the creative factors in the development of the vast and rapidly growing irrigation load of the Far West have won this business very largely through their knowledge of the problems of the farmer. It is no small tribute to the measure of the men who represent the industry in that part of the country. The natural trend of any man's interest and ambition is to specialize and excel in his own elected province, and it is all too common for the expert to ignore the dignity and importance of the other man's profession. Apparently the application of electric motors to the irrigation of Western lands has been the product of the co-operation that has had its basis and foundation in an eager study of the practices and economics of the farmer. This has carried the central-station men very far afield and put an extra burden on their minds and time involving no little sacrifice. It bespeaks a brilliant future for this specialized electric service.

Illumination at the Exposition

EACH international exhibition in this country has exceeded its predecessor in the power and grandeur of its artificial lighting. The Panama-Pacific International Exposition of to-day is no exception to this rule, and already its scenic effects by artificial lighting have brought it fame. In the daytime the sun takes entire charge of all outdoor and nearly all indoor illumination. We have to accept the tones, colors and intensities of light that each day provides. In the night time, however, the scene is changed. The scenery is at the disposal and choice of the illuminating engineer. Tones, colors and intensities are at his command over a wide range of commercial availability. He is able not only to simulate the effects of sunlight or moonlight, but also to create new and pleasing effects that neither

sun nor moon could by itself possibly produce. In this sense, therefore, artificial lighting has a potential range of esthetic effects far beyond natural lighting. During the last twenty years the material for supplying artificial light at the behest of the illuminating engineer has been rapidly increasing. New and powerful arc and incandescent lamps have been produced. Improved reflectors, lenses and color screens have multiplied. The idea of generating large fluxes of light under scenic control has been greatly enhanced, so that very much more strange, novel and powerful illuminating effects are possible to-day than in past decades. The illustrated description published in this issue on the lighting of the Panama-Pacific International Exposition at night shows what new and fine effects have been obtained there. There is the range from a battery of forty-eight arc-lamp projectors to the "fireless fireworks" produced by illuminated steam. With nearly all Europe in the horrors of war and destruction, it is indeed comforting to think of the great achievements in decorative lighting and beautiful illumination at San Francisco.

San Francisco Transmission Systems

The city of San Francisco is the center of the most elaborate energy-transmission network in the world, covering almost the whole northern part of the State of California and consisting of a group of eight interconnected systems, of which that of the Pacific Gas & Electric Company is the chief. This system is itself the result of consolidation of a number of individual transmission systems organized independently and eventually merged. It serves an area of 37,775 square miles, half as large as the whole of New England, and includes fourteen generating stations, ten hydroelectric and four steam. Two of the component plants, those at Folsom and Newcastle, date back to the earliest days of energy transmission, and the others have been taken on from time to time, winding up with the new plant at Drum, with an initial equipment rating of 25,000 kw. All the stations, whether driven by water or steam, operate at sixty cycles and in general feed energy to a 60,000-volt network. The Drum plant feeds energy into the center of distribution of the system at 110,000 volts.

From an engineering standpoint the most interesting feature of this system resides in the fact that all equipments are operated in multiple without the slightest difficulty. The plants are so widely separated, and the flexibility conferred by the electro-dynamic constants of the line is so great, that all of the plants have operated in parallel without any trouble in regulation. Although the system can easily be split into sections if necessary, unified operation is the general rule of procedure. All the stations are equipped with accurate governing apparatus, but the burden of regulation—that is, of taking up the fluctuations of load—is thrown systematically on one or another of the large plants. Except in the single plant for the time engaged in the chief work of taking care of the load fluctuations, the governors are set to act rather sluggishly and operate only on notable variations of speed. A large part of the San Francisco load proper is taken by the steam station, the transformers uniting it with the hydroelectric line being of only 9000-kw rating. In practice it is found that in the operation of the system in multiple there is no surging between plant and plant and no tendency to drop out of step.

In addition to the main system of the Pacific Gas & Electric Company, six other transmission systems are joined in a general network with reciprocal relations, so that at times as many as nineteen stations are feeding energy into the network. Several of these operate at or above 100,000 volts, each delivering energy throughout important territory as well as to the general system. One of the component plants is specially interesting in that it includes a 28,000-kw steam plant in San Francisco which is united with its transmission line, 154 miles at 100,000 volts, by a four-mile 11,000-volt submarine cable across San Francisco Bay. Another of the group has 138 miles of 104,000-volt line and a third 136 miles of 110,000-volt line. For a complete view of this great group of interconnected plants reference must be had to the descriptive article itself, which with the map gives a very vivid idea of what is undoubtedly the most impressive transmission network in the world.

Electrical Energy for Irrigation

From time to time we have referred to the progress made by some of the Western transmission companies in building up irrigation loads. In the present issue there is summarized in a most instructive manner the progress made upon the Pacific Coast in this development. Through all that territory formerly known as the "Great American Desert" the possibilities of irrigation are limitless. Even the most unproductive-appearing land generally becomes a garden spot the moment it is supplied with water, and while over a large part of the arid territory irrigation companies have done admirable work in water supply, there are many tracts of valuable land not yet within reach of such a remedial agent. In many such cases the advent of transmission networks has provided a cheap and easy remedy.

Beginning at the north, the Yakima and Columbia River valleys, together with much of the Walla Walla Valley, depend on irrigation for successful crops. An adequate supply of water can frequently be obtained from wells or lifted from the river. Throughout this region the Pacific Power & Light Company has been active in taking on pumping load. On the average, one may reckon on about six acres irrigated to the horsepower, at an average cost not far from $3 per acre.

Further south, in the San Joaquin Valley, a territory about 200 miles by 50 miles in area has been successfully exploited in a similar way. From the network serving that territory 700 pumping plants are driven with a connected load of nearly 900 hp. The gross income to the transmission company from the pumping load is about $250,000 per year, and, the territory actually irrigated and successfully brought under cultivation from this method of irrigation being over 100,000 acres, the

average cost per acre irrigated is somewhat less than $3. Still further southward the Mount Whitney Power & Electric Company now furnishes energy for about 50,000 acres, ordinarily at the flat annual rate of $50 per hp. The Pacific Gas & Electric Company is carrying a load of nearly 35,000 hp in irrigation motors in the central part of California. Electricity is sold on meter rate throughout this territory varying from 1.25 to 3.0 cents per kw-hr., and the load has proved a good and profitable one. The Great Western Power Company, with 8000 hp in irrigation motors, takes care of another section of central California, while in the southern country the Southern Sierras Power Company has undertaken the same work with good success. Within its territory in the vicinity of Los Angeles the Pacific Light & Power Corporation has undertaken irrigation with excellent results.

Electrical pumping for irrigation has proved particularly advantageous for the farmers. It enables land under cultivation to be irrigated just when it is needed without reference to the limitations of a ditch system. In some cases it has proved advantageous for a group of farmers to equip a pumping plant together and use the water in turn as it may be required. More generally a pumping plant is installed on a fairly large ranch where it can be kept regularly in service. For this work the motor has replaced the gasoline engine to a very great extent as a cheaper and more convenient source of energy. Electric pumping for irrigation may certainly be regarded as long past the experimental stage, as having proved its usefulness and economy, and as giving to the electrical supply company in any region where a reliable water supply is needed an important and profitable source of income.

Electrical Development on the Coast

The States of Washington and Oregon together with California show the greatest use of electricity per capita obtaining in any part of the country, the cheapest electrical supply, and the best utilization of the national resources. They possess over 40 per cent of the aggregate water-power of the country and have utilized it to a very remarkable degree. In fact, it was on the Pacific Coast that the first serious attempts at electric-energy transmission in the country were made, more than twenty years ago. Moreover, in this territory many of the great experiments in transmission have been carried out—the development of high voltage, the working out of the problems of parallel running of large numbers of plants, the simplification of protecting apparatus, the working out in theory and in practice of long lines, and in general the pioneer work of electrical-energy transmission. This splendid development has been attributable in part to the enterprise and initiative of the people and in part to the situation, especially favorable for transmission work on account of the relative cheapness of hydraulic developments and the comparatively high cost of fuel.

In most of the hydraulic work on the Pacific Coast the heads available have been high, the streams being fed from the mountain snows, and on the whole the costs of development have been much lower than in the eastern section of the United States, where the difficulties of low-head developments continually confront the engineer. One section of the Pacific country in the States of Oregon and Washington experiences the highest rainfall known in the United States, the annual average being between 80 in. and 100 in., while in parts of the southern territory the rainfall reaches scarcely more than a tenth of this amount. North or south the hydraulic developments have been, on the whole, relatively easy, and fortunately so to compensate for the long distances between the source of energy and the market, with the comparatively scant population still further increasing the average investment charge in transmission lines.

Speaking broadly, the northern territory in the States of Oregon and Washington is the seat of transmission systems of moderate length only in part interconnected. They have been erected by various interests to serve separate territory, sometimes in competition with still other plants. While some consolidations have taken place, there is no such unification of the transmission interests as exists in the network which centers at San Francisco. To the southward, on the other hand, lies a territory in which consolidation, while not complete, has been carried out to a very large extent. The oldest, and for the time being the largest, of the Southern California networks is that of the Southern California Edison Company, covering the territory just below the mountains from Redlands to the sea. There are seven hydroelectric and three steam stations, distributing energy at the rate of nearly 300,000,000 kw-hr. per year. With the exception of the great installation of the Kern River, its hydroelectric plants lie in the canyons where the streams run southward from the mountains and, with the exception just noted, involve no very long transmission lines. Plans are now on foot for four new developments on the Kern River, still further adding to the present supply of energy.

Two other southern systems are those of the Pacific Light & Power Corporation, with its most interesting 240-mile transmission line from the Big Creek plant, and the Southern Sierras Power Company, having a main plant on Bishop Creek with a 240-mile transmission line and extensions carrying it even beyond the Mexican border and forming by far the longest energy-transmission system in the world. Both of these plants, which are of great interest, have recently been described in our columns. The former with its auxiliary steam and water plants has a yearly kilowatt-hour output again nearing the 300,000,000 mark. Altogether these three great systems are monuments to the magnificent energy which the Pacific Coast has displayed in making most of its natural resources. They are full of lessons to the rest of the country. We advise every Eastern engineer who is fortunate enough to reach the Pacific Coast to spend every hour he can spare in studying these developments and winning from them fresh inspiration to do things in a big way and with big aims.

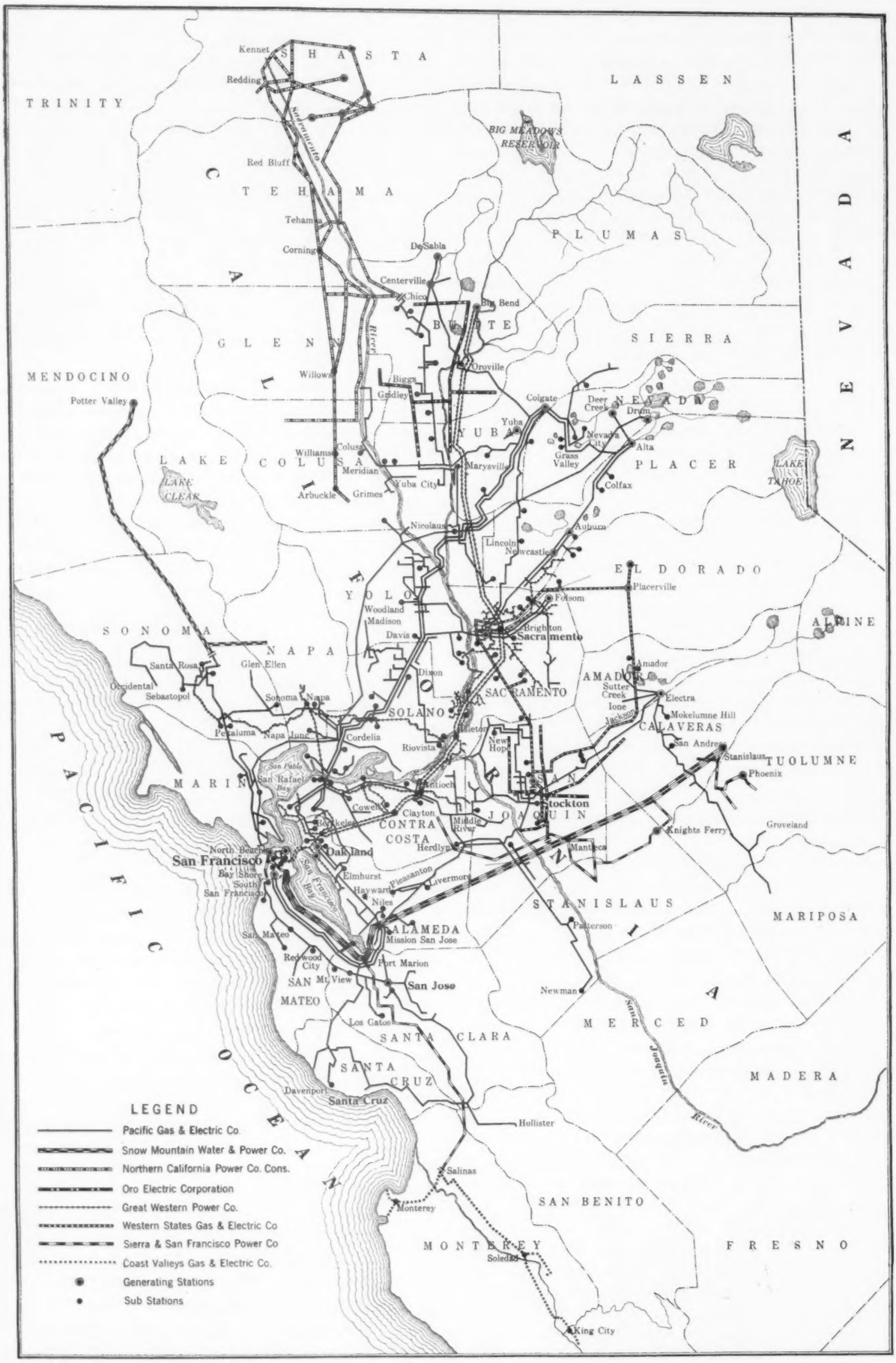


FIG. 1—MAP SHOWING THE INTERCONNECTED TRANSMISSION SYSTEMS LEADING INTO SAN FRANCISCO

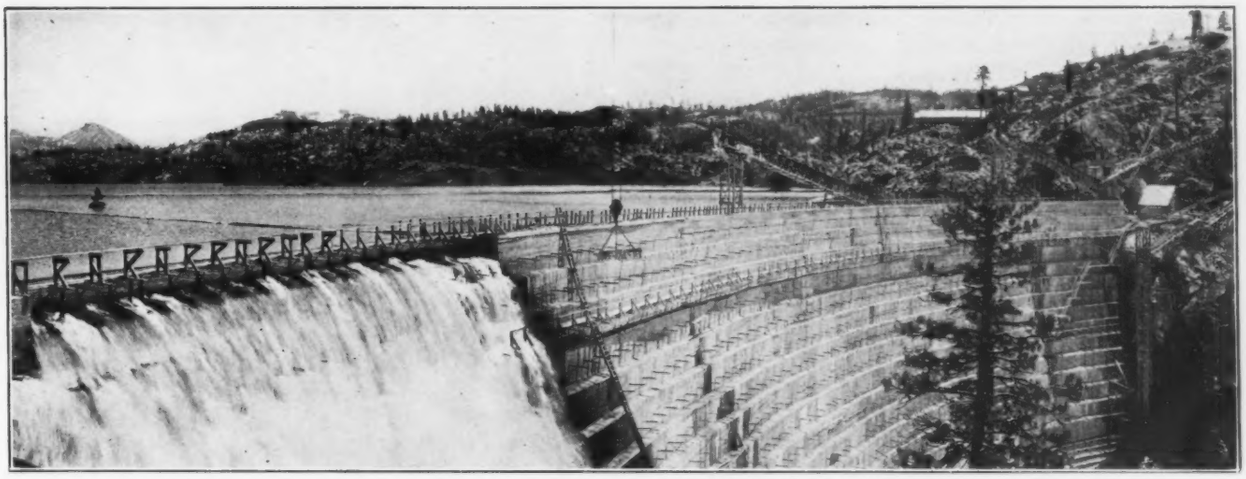
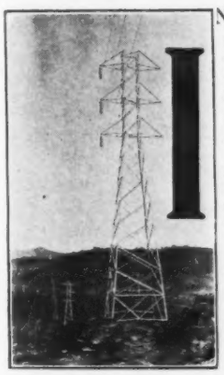


FIG. 2—PANORAMA OF THE SPAULDING DAM OF THE PACIFIC GAS & ELECTRIC COMPANY

Interconnected Systems Serving San Francisco

Details of the Generating Equipments and Transmitting Circuits Tied in with the Larger System of the Pacific Gas & Electric Company, Which Covers Half of California



INSURING continuity of service in the fullest sense, all of the great long-distance transmission systems finding their way into San Francisco are, for mutual protection as well as for other reasons, interconnected in that city and in the adjacent territory, while some of the companies also receive energy from still other companies at various points on the line. The advantage of such an arrangement from a purely operating viewpoint has been more than amply demonstrated on numerous occasions, one company being able to carry the load of another company which has suffered a mishap.

The system of the Pacific Gas & Electric Company is the largest in the West, and possesses the most generating stations. However, in years gone by the company was unable to generate sufficient energy to meet the demands and found it expedient to contract for energy in bulk from some of the other hydroelectric systems not so situated. The Northern California Power Company has a contract, expiring in December, 1925, to deliver 10,667 hp to the Pacific Gas & Electric Company at Chico, where connection is made with the latter company's system. The Snow Mountain Water & Power Company delivers 3750 kw into the system of the Pacific Gas & Electric Company at Santa Rosa, and the Great Western Power Company delivers as high as 15,000 kw into the Pacific Gas & Electric Company's system at Oakland. A reciprocal arrangement exists between the Pacific Gas & Electric Company and the Sierra & San Francisco Power Company, whereby power up to 25,000 kw may be transferred from one system to the other at San Francisco. On the other hand, the Pacific Gas & Electric Company delivers 4500 kw to the system of the Western States Gas & Electric Company at Stockton, Natomas and Richmond. It also delivers 3375 kw to the Oro Electric Corporation at Stockton, Oroville, and at some of the dredges of the Oro Corporation. The Sierra & San Francisco Power Company delivers energy also to the Coast Valleys Gas & Electric Company at

FINANCIAL AND PHYSICAL DATA FOR CENTRAL CALIFORNIA CENTRAL-STATION COMPANIES AS OF DEC. 31, 1914

	Pacific Gas & Electric Company	Great Western Power Company	Sierra & San Francisco Power Company	Northern California Power Company, Consolidated	Oro Electric Corporation
Par value of bonded debt outstanding in hands of public	$75,056,300.00	$21,704,000.00	$15,556,000.00	$7,038,200.00	$2,163,000.00
Stock issue outstanding in the hands of public	*$50,910,600.00	$27,500,000.00	None	$10,000,000.00	$9,750,000.00
Taxes paid in 1914	$743,047.25	$136,000.00	$55,165.53	$38,338.50	$10,740.83
Annual interest paid on bonds, 1914	$3,890,341.43	$998,000.00	$773,143.05	$393,929.98	$73,980.00
Dividends paid in 1914	$614,983.37	None	None	None	None
Gross revenue in 1914	$17,220,504.00	$2,681,000.00	$1,162,738.16	$771,186.57	$268,348.15
Number of employees, all classes	4648	1000	196	186	60
Number of hydroelectric plants and aggregate rating	Ten plants, 121,059 hp	One plant, 75,000 hp	Three plants, 50,100 hp	Seven plants, 50,067 hp	Two plants, 3000 kw
Number of steam stations and aggregate rating	Four stations, 109,517 hp	Two plants, 43,000 hp	Two plants, 28,418 hp	None	One plant, 1000 kw
Annual load-factor, per cent	60.6	68	51.2	66.8	81
Number of consumers served	378,705	17,000	3717	7931	2063
Installed lighting load in horse-power	211,720	175,000	2548	7663	1375
Installed motor load in horse-power	266,878		65,310	37,196	975
Number of municipalities served	177	17	19	8	1

* Includes $8,801,300.00 of first preferred stock subscribed for but not fully paid and issued.

Salinas, and to the Western States Gas & Electric Company at Manteca, and purchases energy from the City Electric Company, a subsidiary of the Great Western Power Company in San Francisco. It is connected with the Tuolumne Transmission Company at Tuolumne, and also with the West Side Lumber Company, both of these companies doing a general public utility business.

Certain financial and statistical data of the principal interconnected companies are given in the table printed on page 1357.

Pacific Gas & Electric Company

The system of the Pacific Gas & Electric Company represents the consolidation of a number of smaller companies, each with a system peculiar to itself and none of them originally designed with a view of being tied in with any other system. The company at present operates ten hydroelectric stations and four steam stations. The hydroelectric stations are located and rated as follows:

Power House	Rating in Kw	Generator Voltage
Drum	25,000	6,600
Electra	20,000	2,300
Colgate	14,200	2,300
De Sabla	13,000	2,300
Centerville	6,400	2,300
Deer Creek	5,500	2,300
Folsom	3,750	800
Alta	1,000	500
Newcastle	800	500
Yuba	660	2,300

Steam stations are located as follows:

Power House	Rating in Kw
San Francisco	54,000
Oakland	21,000
Sacramento	5,000
San José	2,300

All of the stations operate at a common frequency of sixty cycles and run in parallel on a 60,000-volt network, which is also supplied with additional energy from various other interconnected systems. The energy from the latest and largest station of the company, known as the Drum station, is transmitted at 110,000 volts to a substation at Cordelia, where the load center of the Pacific company's system is. From this point electricity is distributed radially at 60,000 volts to the cities and valleys surrounding the bay.

The area served by the Pacific Gas & Electric Company is 37,775 sq. miles, or equivalent to a territory one-half the size of all the New England States combined or three-fifths the size of the State of New York. The circuits extend into thirty of the fifty-eight counties of the State of California, containing within their borders the most thickly populated sections of the State centering between San Francisco and San Francisco Bay, the fertile Sacramento, Santa Clara, Sonoma and Napa Valleys and a large portion of the San Joaquin Valley. These counties have an area of approximately 37,000 sq. miles, and according to the 1910 census had a population of 1,325,000, or about 55 per cent of that of the entire State. Electricity is supplied directly or indirectly through other companies to 214 cities and towns, the cities served being the eleven largest in the State. A complete description of the property of the company was given in the ELECTRICAL WORLD June 1, 1912, since which time the Drum development has been built and additions have been made to the steam station in San Francisco.

There are at times nineteen generating systems operating in parallel. At the beginning of 1914 the total length of the company's transmission and distribution lines was 5090 miles. Not only is the entire system of the Pacific Gas & Electric Company welded together in a single operating unit, and all of the various stations so interconnected and controlled that in case of accident or variation of load the burden may be thrown onto other power houses and transmission lines, but through its interconnections with the other large generating systems around San Francisco there can be a very wide interchange of load between these systems and the system of the Pacific Gas & Electric Company in case of accident to any one of them. This insures continuity of service throughout the entire field of operations and is an important element of strength, particularly in view of the necessity of uninterrupted service to many large industries depending upon the various companies for electric supply.

The paralleling of the various stations regardless of the length of line between them or the loads carried has not developed any difficulties, but on the contrary it has been found that paralleling can be done much more readily in such cases than when the generators are paralleled in the same station. The systems may be paralleled at the generating stations or on the low-voltage side of substations. As

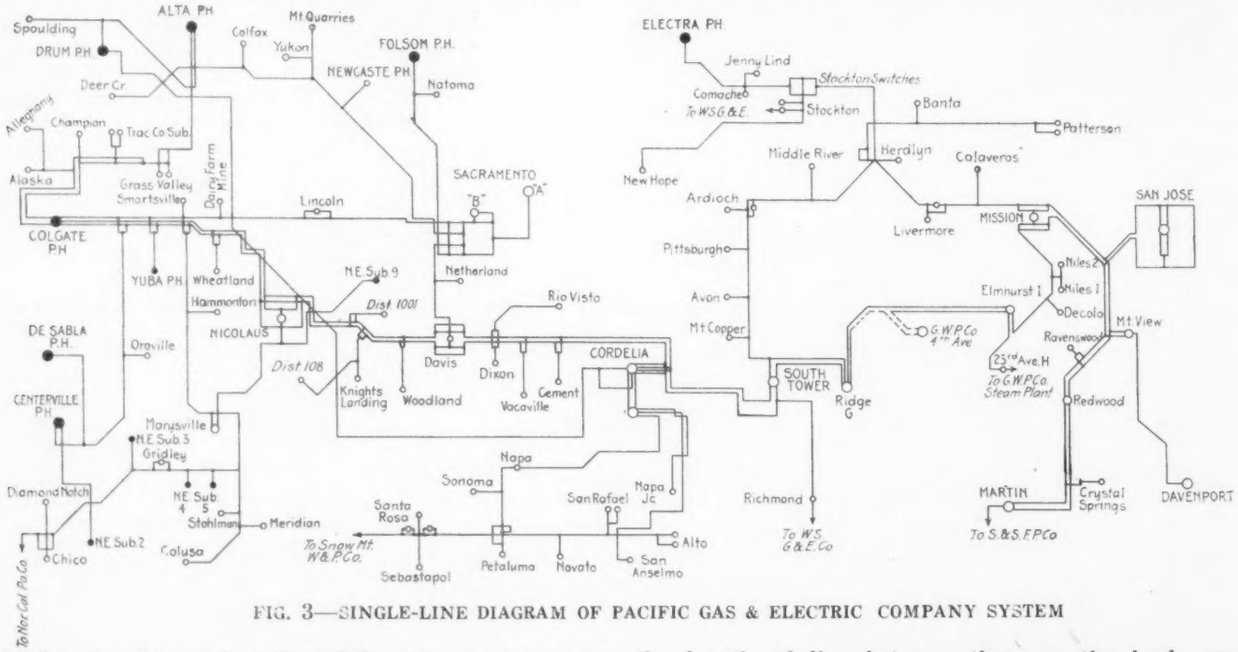


FIG. 3—SINGLE-LINE DIAGRAM OF PACIFIC GAS & ELECTRIC COMPANY SYSTEM

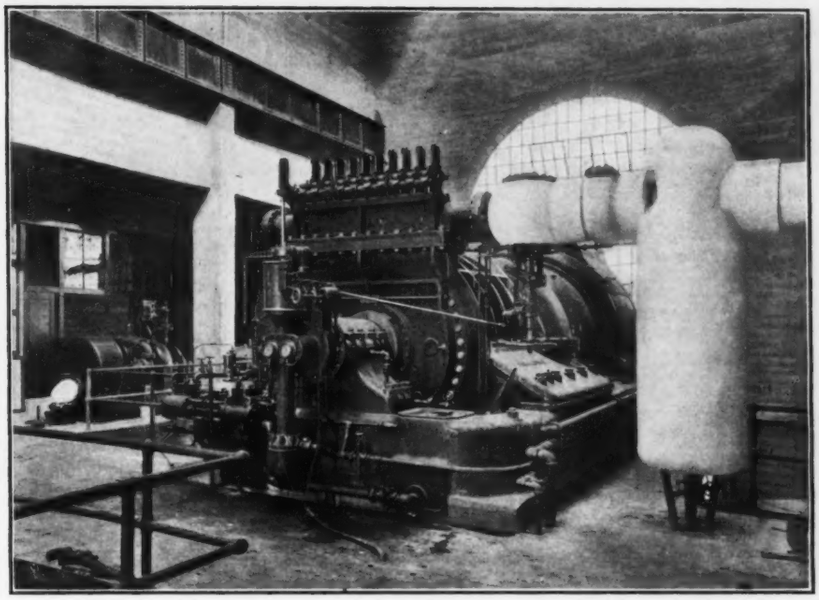


FIG. 4—STEAM TURBINE SET IN RIVER STATION, SACRAMENTO

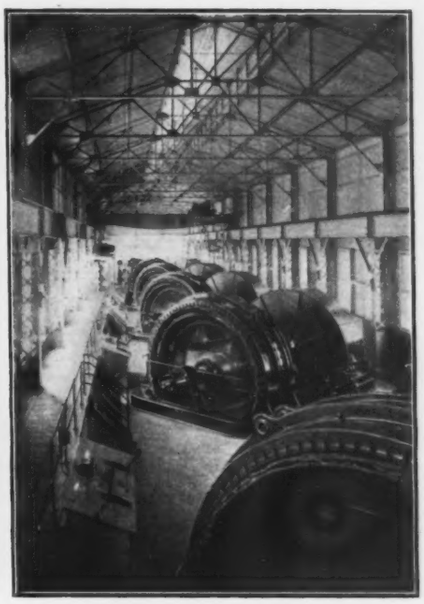


FIG. 5—INTERIOR OF ELECTRA PLANT

FIG. 6—THE CENTERVILLE WATER-POWER PLANT—A 2300-VOLT STATION

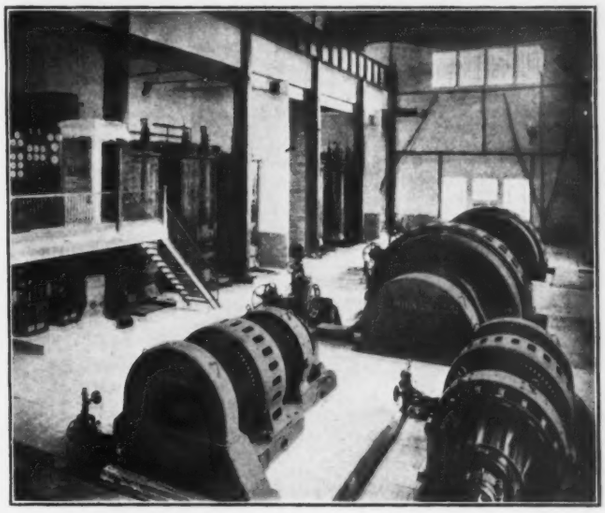


FIG. 7—THE 25,000-KW DRUM STATION IS THE LARGEST OF THE COMPANY'S WATER-POWER PLANTS

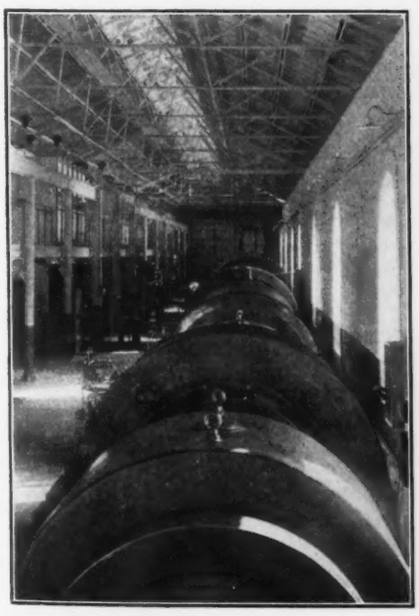


FIG. 8—THE 20,000-HP COLGATE PLANT

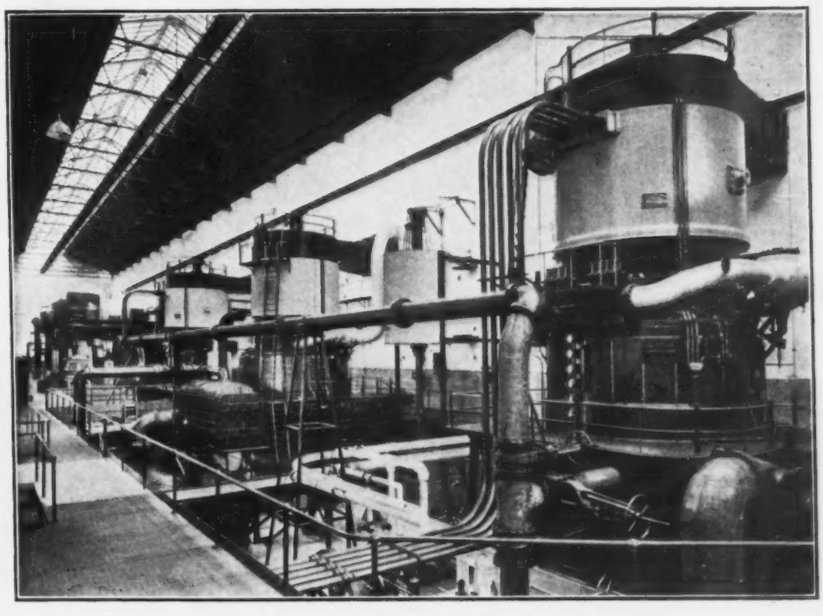


FIG. 9—THE 54,000-KW SAN FRANCISCO STEAM STATION

GENERATING EQUIPMENTS OF THE PACIFIC GAS & ELECTRIC COMPANY

TERRITORY SERVED			MISCELLANEOUS	
Area	Population of District	No. of Electrical Consumers Served	Gross Annual Earnings	Companies with Which Connected Electrically
37,750 sq. in.	1 125,068	148,957	$8,759,449 from sale of electricity alone for year ended Dec. 31, 1914	Buys from Great Western Power Co., Northern California Co. and holds exclusive contract for supplying energy to Panama-Pacific International Exposition

GENERATING STATIONS CONNECTED ELECTRICALLY

Location or Name	Rating in Kva	Type (Steam or Hydraulic)	Date Built or Rebuilt
Alta	1,000	H	1900
De Sabla	13,000	H	1903
Centerville	6,400	H	1900
Colgate	14,200	H	1899
Deer Creek	5,500	H	1908
Electra	20,000	H	1899
Folsom	3,750	H	1895
Newcastle	800	H	1896
Drum	25,000	H	1913
Yuba	660	H	1898
Station A, San Francisco	54,000	S	
Station C, Oakland	21,000	S	
Station B, Sacramento	5,000	S	
San José	2,200	S	

MAIN GENERATORS

Station	No.	Voltage	Phases	Cycles	R.p.m.	Kva (Each)	Type
Alta	1	500	3	60	400	1,000	General Electric
De Sabla	2	2,300	3	..	240	2,000	Stanley
	1	2,300	3	..	400	5,000	Stanley
	1	2,300	3	..	400	4,000	Stanley
Centerville	1	2,300	3	..	400	5,500	Stanley
	1	2,300	3	..	360	900	Stanley
Colgate	1	2,400	3	..	300	5,500	Westinghouse
	3	2,400	3	..	300	2,000	Stanley
	3	2,400	3	..	300	900	Stanley
Deer Creek	1	2,300	3	..	300	5,500	Westinghouse
Electra	5	2,300	3	..	240	2,000	Stanley
	2	2,300	3	..	400	5,000	Stanley
Folsom	5	800	3	..	300	750	General Electric
Newcastle	2	500	3	..	400	400	General Electric
Drum	2	6,600	3	..	360	12,500	Westinghouse
Yuba	2	2,400	2	..	400	300	Stanley
Station A, San Francisco (steam)	1	500	..	60	....	500	Westinghouse
	3	500	..	60	....	1,500	Westinghouse
	1	11,000	..	60	....	12,000	General Electric
	2	11,000	..	60	....	15,000	General Electric
	2	11,000	..	60	....	3,500	Westinghouse
Station C, Oakland (steam)	1	4,150	3	60	720	9,000	General Electric
	1	4,150	3	60	720	12,000	General Electric
Station B, Sacramento (steam)	1	4,150	3	60	1800	5,000	
San José (steam)	1	2,300	..	..	....	400	General Electric
	1	2,300	..	..	....	1,500	General Electric
	1	2,300	..	..	....	300	General Electric

STEAM GENERATING EQUIPMENT

	BOILERS						CONDENSERS		
Station	No.	Hp or Effective Heating Surface (in Sq. Ft.)	Steam Pressure (Lb. per Sq. In.)	Facilities for Raising Steam Quickly	Type	Fuel	No.	Type	Area, Sq. Ft.
Station A, San Francisco	15	5240	200	Keep boilers operating under light load so they may be forced	B. & W.	Oil 18,500 lb. Fahr. units	8	Surface type	91,426 (total)
	6	6860	200		B. & W.				
	5	5500	200		Heine				
Station C, Oakland	4	7734	200	Fire groups of boilers in rotation to keep all hot	Parker	Do.	1	Worthington	20,000
	8	7550	200		McNaull		1	Worthington	25,000
Station B, Sacramento	6	823	200	Do.	Stirling	Do.	1	Wheeler surface type	10,000
San José steam plant	4	3146	150	.....	B. & W.	Do.	..	.....	.....
	1	5000	150		Heine				
	1	2000	150		Heine				
	1	3000	150		Heine				

STEAM AND WATER-POWER EQUIPMENTS OF THE PACIFIC GAS & ELECTRIC COMPANY

PRIME MOVERS

Station	No. of Sets	Rating (Each)	R.p.m.	Horizontal or Vertical	Type	Connection with Generator	Governor (Type)
Alta	1	1,333 hp	400		Victor Gerard waterwheel	Directly connected	
De Sabla	2	2,000 kw	240	Horizontal	Doble impulse	Do.	Deflecting needle nozzle
	1	5,000 kw	400	Do.	Doble impulse	Do.	Do.
	1	4,000 kw	400	Do.	P., G. & E. waterwheel	Do.	Do.
Centerville	1	9,700 hp	400	Do.	Francis-Allis Chalmers	Do.	Wicket gate with relief valve
	1	1,500 hp	360	Do.	Doble impulse	Do.	
Colgate	7	14,200 kw (total)	240	Do.	Risdon Iron Works, twin impulse wheels	Do.	Do.
			300	Do.	Doble impulse	Do.	Do.
Deer Creek	2	5,500 kw (total)	300	Do.	Pelton	Do.	
Electra	5	3,000 kw	240	Do.	Pelton	Do.	
	2	7,500 kw	400	Do.	Doble	Do.	
Folsom	4	1,200 hp	300	Do.	McCormick double discharge	Do.	
	1	1,200 hp	300	Do.	Do.	Do.	
Newcastle	2	600 hp	400	Do.	Pelton	Do.	
Drum	4	8,500 hp	360	Do.	Pelton Doble	Two directly connected with each of two generators	Deflecting needle nozzle
Yuba	2	300 kw	400	Do.	Pelton	Directly connected	
Station A, San Francisco (steam)	1	15,000 kw	720	Vertical	Six-stage Curtis (steam)	Do.	
	1	12,000 kw	720	Do.	Five-stage Curtis (steam)	Do.	
	1	15,000 kw	720	Do.	Seven-stage Curtis (steam)	Do.	
	1	500 kw	115		Cross-compound McIntosh & Seymour	Do.	
	3	1,500 kw	115		Do.	Do.	
	2	3,500 kw	106		Triple-expansion, Union Iron Works	Do.	
Station C, Oakland (steam)	1	9,000 kw	720	Vertical	Five-stage Curtis	Do.	
	1	12,000 kw	720	Do.	Do.	Do.	
Station B, Sacramento	1	5,000 kw	1800	Horizontal	Six-stage Curtis	Do.	
San José steam plant	1	400 kw	100	Do.	Cross compound McIntosh & Seymour		
	1	1,500 kw	100	Do.	Do.		
	1	300 kw	600	Do.	E. P. Allis		

HYDRAULIC DETAILS

Station	Average Flow of Water Available (in Cu. Ft.)	Storage Available (in Cu. Ft.)	Dam Details
Drum. Area of drainage basin is 120 sq. miles	350 (400 max., 270 min.)	4,000,000,000	305 ft. dam; lower 260 ft. has gravity section with stepped face; upper 45 ft. is arched and vertical; spillway 75 ft. long
Alta	.....	.....	.....
Centerville	190	38,000,000	15 ft. arched dam made of concrete and boulders; 90 ft. long along crest
Colgate	.....	110,000,000	.....
Deer Creek	.....	.....	Concrete
De Sabla	180	38,300,000	.....
Electra. Takes water from four lakes	243	.....	.....
Folsom	.....	.....	.....
Yuba	.....	.....	.....
Newcastle	.....	.....	.....

CONDUITS FOR WATER

Type	Length (in Ft.)	Head Furnished (in Ft.)
8 ft. 8 in. solid-granite concrete-lined tunnel with relief valve	4456	1375
Ditch	39,631	
Flume	2,602	
Siphon with relief valve	3,600	
Two riveted-steel pipe lines from forebay to station 72-in. to 52-in. dia., with relief valves	6,282	
.....	.....	660
Two systems: one consists of canal and flume, 7 ft. 8 in. by 4 ft. 8 in.	43,800 (approx.)	577
Three riveted-steel pipe lines from forebay to station; one is 42 in. to 36 in. dia.; two 24 in. dia. Six-inch air valves at critical points	2,560	
Flume 7 ft. by 6 ft.	40,000 (approx.)	701
Five 30-in. riveted-steel and cast-iron pipe lines from forebay to station	700	
.....	.....	837
Two systems—one consists of canal and flume	66,000 (approx.)	1531
Two 30-in. riveted-steel and lap-welded pipe lines from forebay to station	6,000	
Canal flume	194,000—103,000	1466 to 1266
Three pipe lines from forebay to station—two consist of wood-stave, cast-iron and lap-welded sections; one is riveted steel	3,600	
.....	.....	55 to 26
.....	.....	292
.....	.....	464

CHARACTERISTICS OF SERVICE

Character of Load	Total Connected Load		Maximum Combined Peak		Distribution of Energy Last Year in Kw-Hr.		
	Lighting	Industrial	Kw	Date	Generated	Purchased	Sold for Distribution
Railway, light and motor service	211,720 hp (equiv.)	266,878 hp	124,040	Oct. 23, 1914	476,597,553	181,700,449	.....

TRANSMISSION EQUIPMENTS OF THE PACIFIC GAS & ELECTRIC COMPANY

PRIMARY SUBSTATIONS		TRANSMISSION, CIRCUIT MILEAGE AT EACH VOLTAGE	DISTRIBUTION	
			Circuit Mileage	
Location or Name	Rating in Kva		Overhead	Underground
118 primary 22 secondary	190,642 (total) 72,293 (total)	110,000 volts, 109 miles 60,000 volts, 1299 miles 24,000 volts, 91 miles 17,000 volts, 102 miles	3685	81

TRANSFORMERS

Station	No.	Kva (Each)	Phases	Voltage		Type
				Low	High	
Alta	3 6	500 375	1 1	500 500	34,000 15,500	Stanley Westinghouse
De Sabla	9 3	840 1500	1 1	2300 2300	34,600 38,100	Stanley Stanley
Centerville	6 3	840 360	1 1	2300 2300	34,000 34,000	Stanley Stanley
Colgate	3 3 6 3	1000 700 700 1500	1 1 1 1	2300 2300 2300 2300	34,600 34,600 17,300 34,600	Stanley Stanley Stanley Stanley
Deer Creek	3	2000	1	2300	34,600	Stanley
Electra	6 6 3	1100 1250 1100	1 1 1	2300 2300 2300	34,600 34,600 17,300	Stanley Stanley Stanley
Folsom	3	1250	1	800	34,600—10,000	General Electric
Newcastle	3 3	300 300	1 1	500 546	34,600 6,900	Stanley Stanley
Drum	6	4250	1	6600	64,000	Allis Chalmers
Yuba	2	300	1	2300	34,600	Stanley

TRANSMISSION SYSTEM

Route	Miles	Height in Ft.		Spacing in Ft.		Voltage	Type	No. of Circuits per Tower	Arrangement of Conductors	Spacing in Ft.	Position of Ground Wires
		Normal	Maximum	Normal, c	Maximum, d						
Drum to Cordelia	110 1299 91 102	82	50	800	2200	110,000 60,000 24,000 17,000	Steel towers	1 and 2	Horizontal and vertical	162 120	None

Route	Height in Ft.		Poles and Towers			No. of Circuits per Tower	Arrangement of Conductors	Spacing in Ft.	Position of Ground Wires
			Spacing in Ft.		Type				
	Normal	Maximum	Normal, c	Maximum, d					
Big Bend to Oakland	71	300	750	2740	Milliken steel towers	Double circuit mainly	In two vertical planes normally, but in one horizontal plane across San Joaquin	10	One 0.375-in. steel wire on apex of towers grounded at every tower

Route	Miles	Topography of Route	Conditions Subjected to	Maximum Elevation Above Sea Level in Ft.
Big Bend to Oakland	154	Marshes and soft ground	No lightning, sleet or bad winds	2000

CONDUCTORS			INSULATORS		
Route	Material and Cross-Section	No. of Strands	Service	No. of Sections	Type
Big Bend to Oakland	No. 000 copper on main line No. 6 copper on branch lines	7	Ordinary Strain	5	Thomas Suspension Locke & Thomas Suspension

a matter of fact, the paralleling is done almost entirely on the 60,000-volt side, transformers of relatively small sizes being connected from line to ground for synchronizing purposes.

The operation of the system is controlled from the office of a load dispatcher in Oakland. This official is at all times in direct telephonic communication with the entire system, and in case of trouble which might interrupt the service has control of all matters in connection with the resumption of service. Water cannot be taken out of a ditch or flume; a power-house superintendent or foreman cannot shut down a generator or change the load carried on the station, and a line crew cannot work on a line without first obtaining the consent of the load dispatcher. In the load dispatcher's office is a board upon which is a working model of the entire system. Every generating station, switching point, transmission line, substation, etc., is shown, and the switches are made up in dummy form for hand setting to correspond with the conditions in the field. Whether the switch is an oil switch or an air-brake switch is indicated by the form of the dummy, the oil switches being circular and the air switches rectangular. The lines of interconnected companies are shown in different colors, as are also lines operating at various voltages. The hydroelectric plants are shown in white, and the line symbols and auxiliary plants are indicated in yellow and white. Substations are shown in white lines and transformer banks are colored according to voltage ratings.

The system of switching in use enables different power stations to be separated, leaving one or more running together upon such lines and loads as can be conveniently carried. A very complete log is kept of every detail in connection with troubles of any kind, loads carried by the different stations, and other matters pertaining to operation. Continuity of service is guaranteed in the more important districts by the steam stations, and since these are all turbine-driven they are operated readily in parallel with the transmission line and under normal conditions carry a good portion of the wattless current. At the same time they serve as a standby, and in case of trouble pick up the load on very short notice. As a rule, the hydroelectric station generators are connected directly to line without automatic circuit-breaking equipment of any kind, and energy is never shut off the lines entirely unless it is absolutely necessary to do so.

The governing of the division of load between the different stations is not so great a problem as might appear. Each station, excepting one, takes its allotted portion of the load and makes no attempt whatsoever to govern unless the frequency varies beyond certain predetermined limits, the speed control being left entirely to a single station. The governing is not limited to any one particular station, but can be done at any station having sufficient equipment to handle the fluctuations of load. All important power houses are equipped with governors which, except in the case of the governing station, are set so as to be sluggish in action and will not operate, therefore, except on wide variations of speed.

It might be thought that with the large steam turbine station in San Francisco the water-power plant would be operated at constant load and that the fluctuations would be taken by the steam plant. While this would undoubtedly be the best arrangement for operation, the fact is that there is not at present enough transformer equipment between the hydroelectric system and the steam system to make it possible for the steam system to govern the whole without overloading the transformers. For instance, the rating of the steam station in San Francisco is 54,000 kw, whereas the transformer equipment between the hydroelectric and the steam system is only of 9000-kw rating. No attempt therefore is made to feed the whole of the San Francisco load with transmitted energy. The units in the new Drum station can be adjusted for speed from no load to full load by the governors. With one unit governing (and one of the Drum units is large enough to govern alone) the governor is set to give the unit the same speed at full load as it does at normal load.

The parallel operation of the system as a whole is very satisfactory indeed, there being no reciprocating

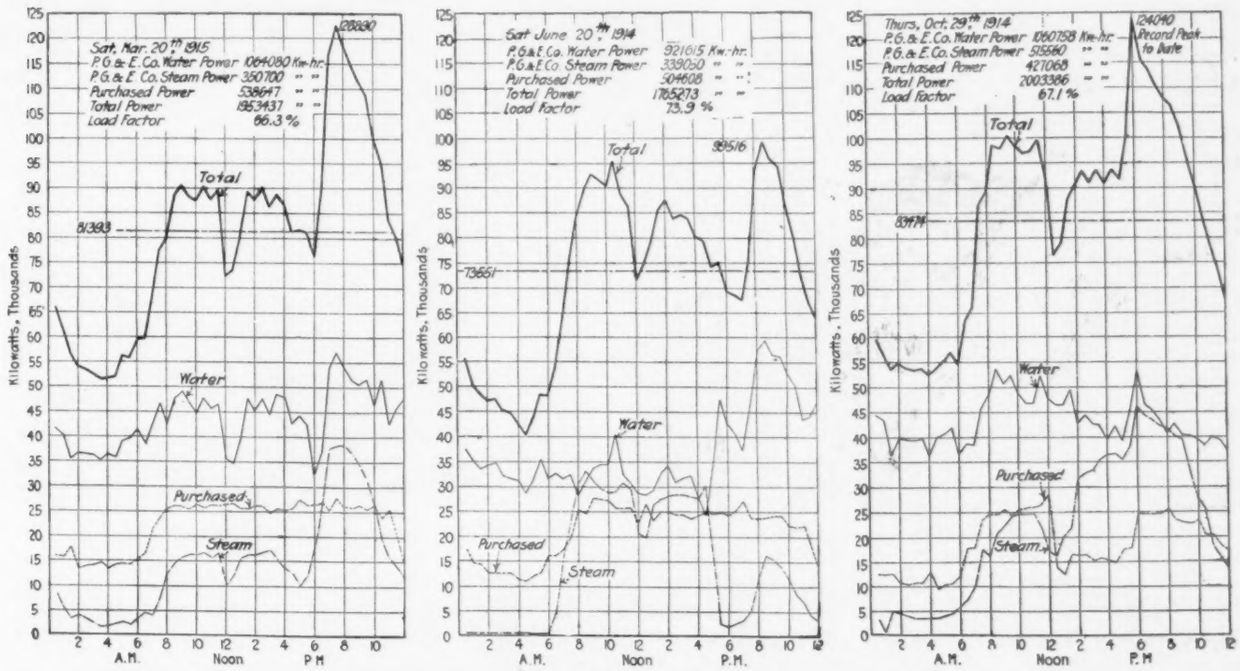


FIG. 10—CURVES SHOWING PROPORTION OF ENERGY GENERATED IN THE PACIFIC COMPANY'S STEAM AND WATER-POWER PLANTS AND THAT PURCHASED FROM OTHER SYSTEMS

FIG. 11—DRUM CANAL—SPAULDING DAM IN DISTANCE

FIG. 12—DE SABLA WATER-POWER PLANT

FIG. 13—DRUM POWER HOUSE

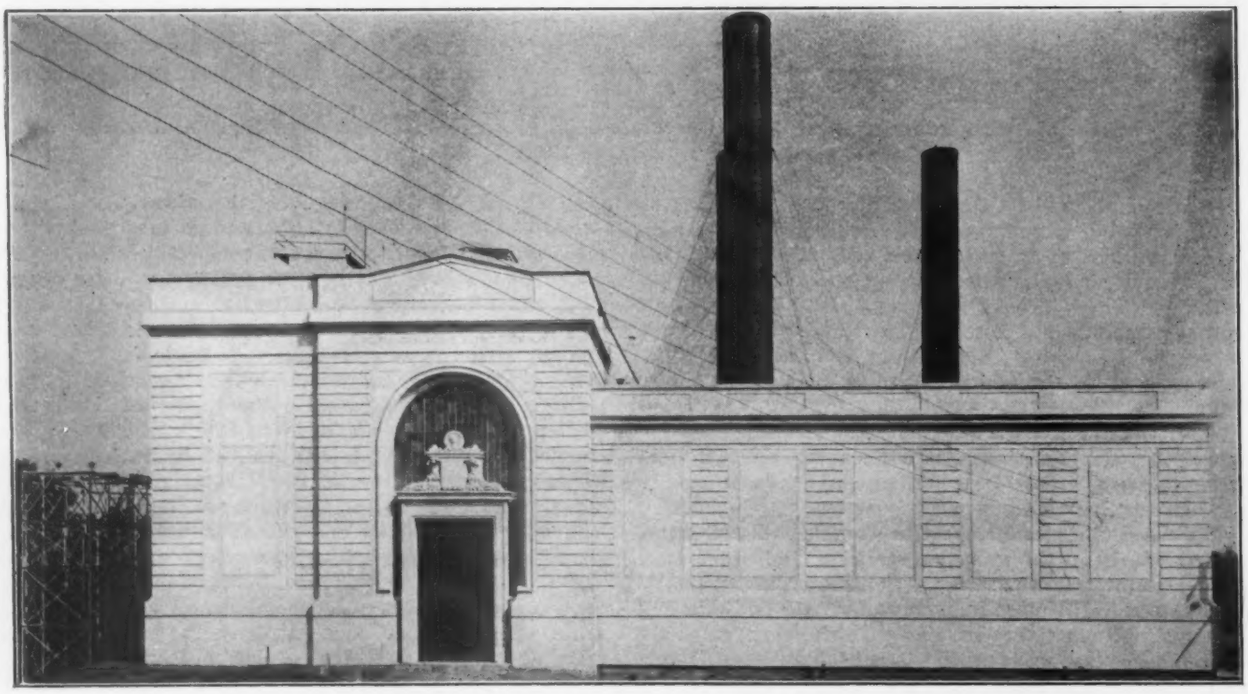


FIG. 14—RIVER STEAM STATION OF THE PACIFIC GAS & ELECTRIC COMPANY AT SACRAMENTO

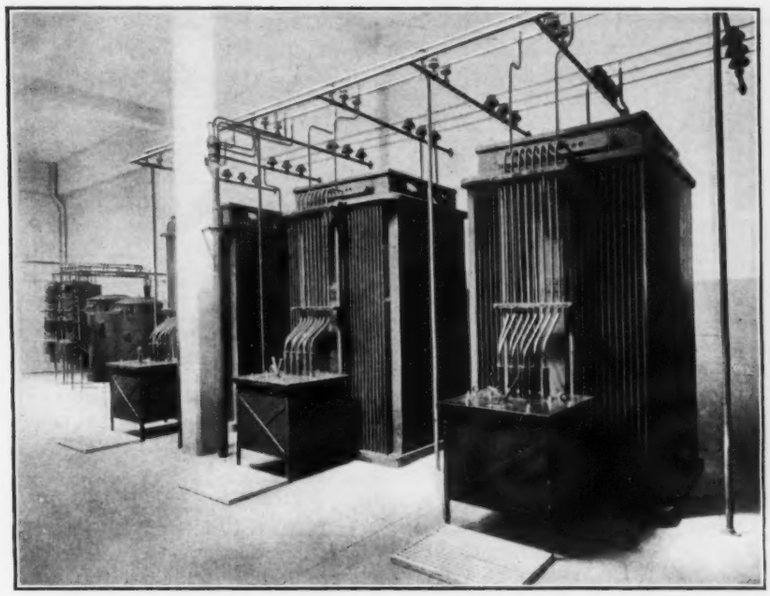


FIG. 15—TRANSFORMER EQUIPMENT IN SAN MATEO SUBSTATION

FIG. 16—CORRIDOR TO BUS COMPARTMENTS IN CORDELIA SUBSTATION

FIG. 17—DIGNIFIED ARCHITECTURE DISTINGUISHES THE SAN MATEO SUBSTATION

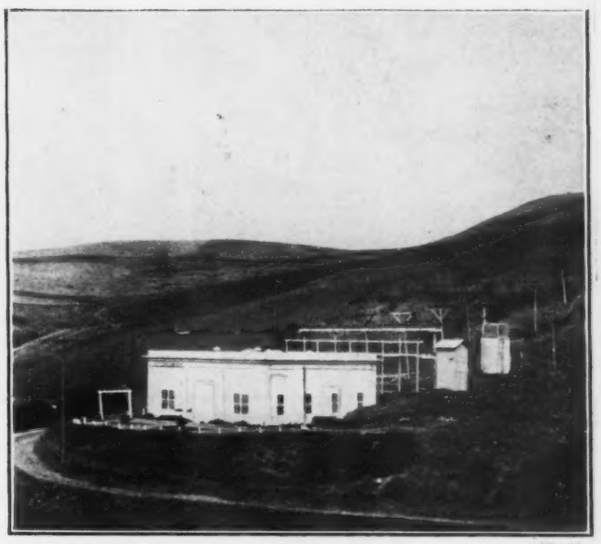


FIG. 18—THE RIDGE SUBSTATION IN THE VICINITY OF BERKELEY

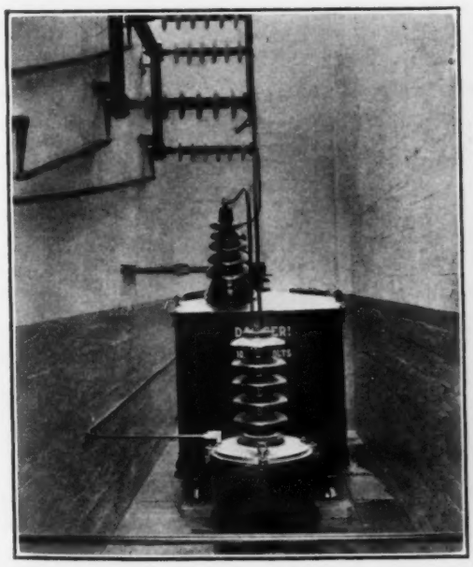


FIG. 19—CORDELIA SUBSTATION TERMINALS

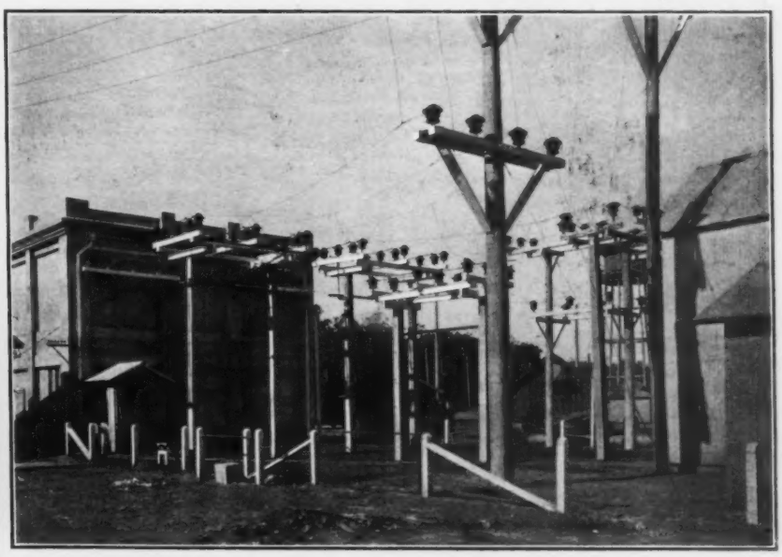


FIG. 20—HIGH-TENSION STRUCTURE IN SUBSTATION YARD, CHICO

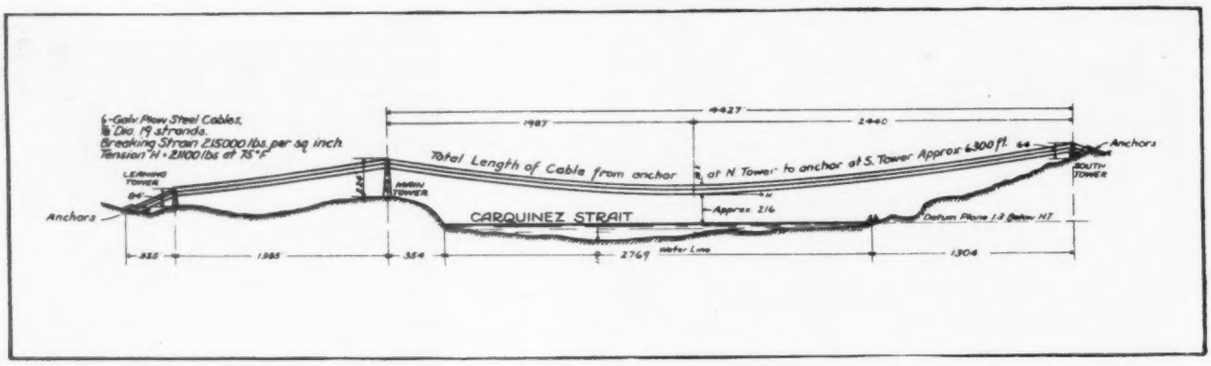


FIG. 21—THE CELEBRATED TWO-CIRCUIT SPAN ACROSS CARQUINEZ STRAIT—CLEAR LENGTH 4427 FT.

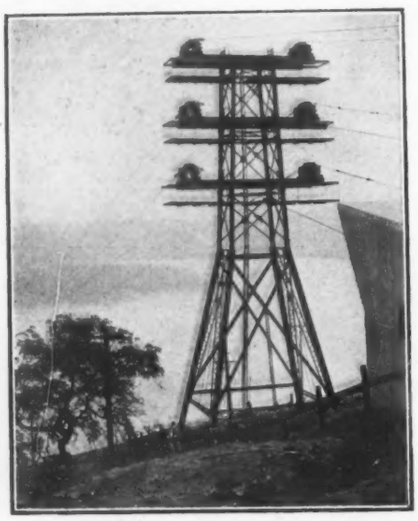


FIG. 22—SOUTH TOWER CARQUINEZ STRAIT CROSSING

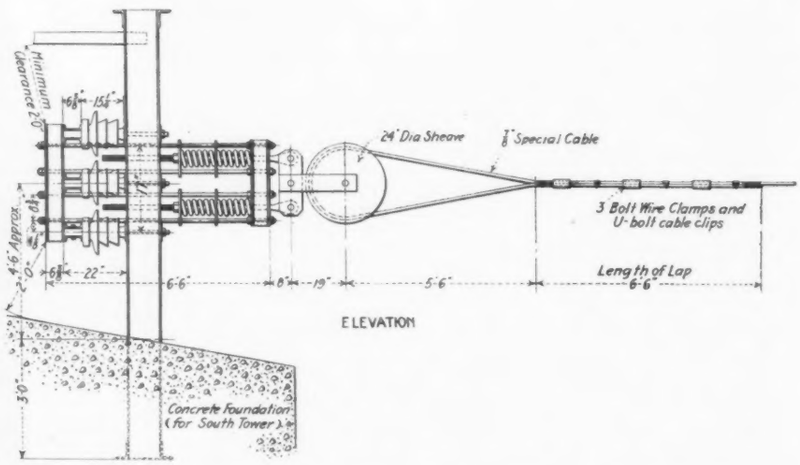


FIG. 23—ARRANGEMENT OF STEEL CABLE ANCHOR AT THE CARQUINEZ STRAIT CROSSING

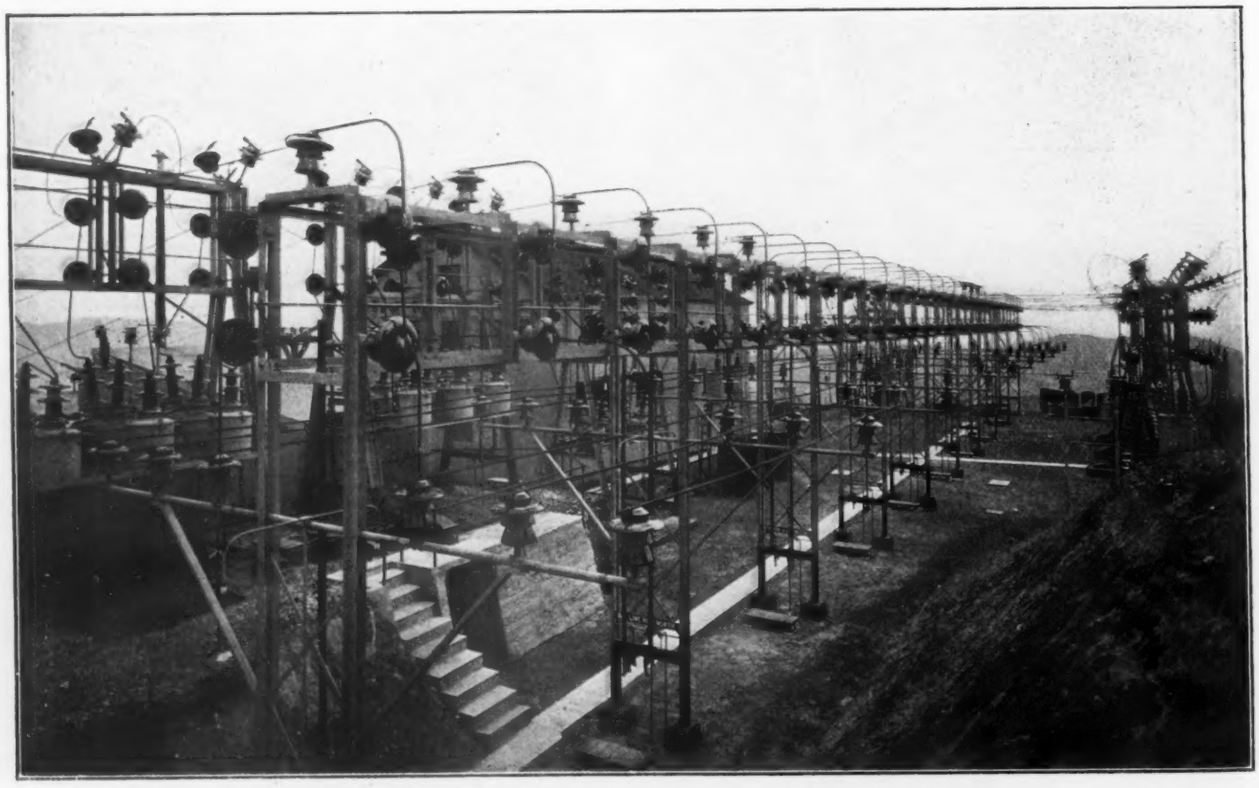


FIG. 24—SWITCHES AT SOUTH TOWER CARQUINEZ STRAIT CROSSING

units whatsoever. The steam turbines and the water-wheels are all of uniform rotating speed so that there is no surging between one unit and another and no tendency to drop out of step. The greater number of the lines feeding into the system are supplied from transformers delta-connected on the low-tension side and star-connected on the high-tension side with the neutral grounded.

Except in the mountain districts the Pacific Coast is comparatively free from lightning, so that the company makes no attempt to protect against lightning disturbances other than to install horn-gaps, which are set to arc on voltages approximately 25 per cent above normal. Ordinarily these arresters consist of two gaps in series with the ground side connected directly to earth without resistance.

Reference has already been made elsewhere to troubles due to fogs which prevail at certain seasons of the year along the Pacific Coast. Broadly speaking, there are two seasons on the Pacific Coast—one wet and one dry—and insulator troubles are usually encountered during dry seasons or just when the first rains start in. The troubles are due chiefly to leakage from the surface of the insulators on account of the dirt and the salt which are deposited by the winds. As soon as the heavy rains come this accumulation is washed off and the number of insulator troubles is materially reduced. Insulators which operate without trouble on the 60,000-volt lines in the mountain districts outside of the fog belt give a great deal of trouble on the 11,000-volt lines in the bay district, where they are exposed to more severe conditions of dust, fog and smoke. The salt finds its way to the insulators in the following manner: The prevailing winds blow from the ocean and carry salt in suspension from the ocean spray of the waves. This, together with the dust, forms a coating on the insulator, and it is evident that trouble ensues as soon as the heavy fogs or rains set in. All of the companies find it necessary to wash the insulators on the lines along the ocean front once or twice a year.

The curves herewith (Fig. 10) show the proportion of energy generated by water-power and steam-power, and the proportion which is purchased by the Pacific Gas & Electric Company. It will be noticed that during certain seasons of the year the company is obliged to use more steam to generate its energy than at other seasons. Prior to the operation of the Drum plant about half of the total output of the Pacific Gas & Electric Company's system was generated by steam and half by water-power. Since the operation of the new Drum station, however, this ratio has been changed, as shown by the curves. California crude oil is used for boiler fuel in all of the steam stations of the Pacific Gas & Electric Company, and in the largest station of the company an average of 217.68 kw-hr. was generated per barrel of fuel oil used throughout the year 1913.

The illustrations show various portions of the Pacific Gas & Electric Company's system. The Cordelia substation, which is situated at the load center of the system, was erected for the purpose of stepping down the potential of the Drum-Cordelia tower line from 110,000 volts to 60,000 volts. It is built in Spanish Renaissance style, as are also many of the other substations and the steam station at Sacramento. Seven 60,000-volt lines radiate from the Cordelia substation as well as some 11,000-volt lines. All of the 110,000-volt and 60,000-volt switches installed in that substation were designed and built by the company. The main transformers are of the auto-transformer type.

The celebrated crossing of the 60,000-volt lines over Carquinez Strait, in the San Pablo arm of San Francisco Bay, has been increased in carrying capacity recently and new anchors provided. Formerly four cables of nineteen-strand galvanized plow-steel wire 7/8 in. in diameter and 6300 ft. long spanned the strait 216 ft. above high tide and brought the electrical energy into Oakland. During the fourteen years of continuous operation this crossing never failed. Two more cables have now been added to the original four, thus providing two independent three-phase lines across the strait, the middle span over which is 4427 ft. long. The four wooden cross-arms were replaced by three pairs of steel I-beams which overhang both sides of the towers. The planes of the two circuits are 20 ft. apart, and the vertical distance between conductors is 10 ft. Details of the cable saddles on top of the towers and of the new cable anchors are shown herewith. The system operating diagram is given in Fig. 3. The Ridge substation in Berkeley is where the 60,000-volt lines terminate. Fig. 39 shows the general equipment of Station F in the Exposition grounds in San Francisco. The appa-

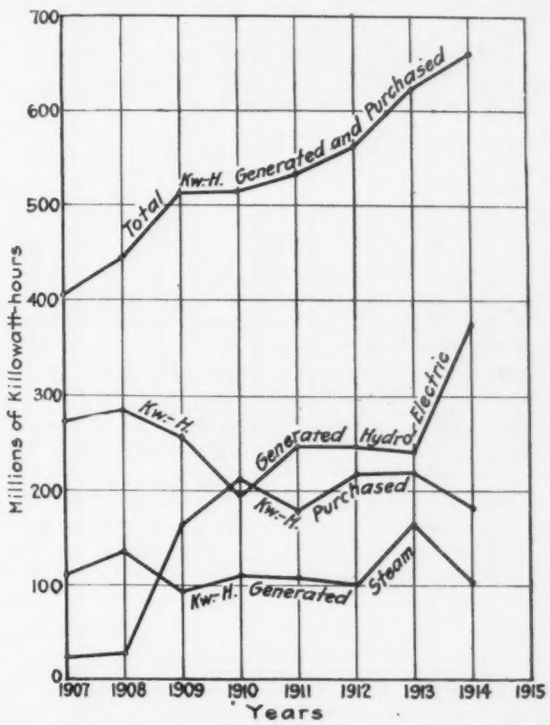


FIG. 25—RECORDS OF ENERGY GENERATED AND PURCHASED DURING RECENT YEARS

ratus is situated in the west end of the North Beach power house of the Sierra & San Francisco Power Company. The 1000-kw motor-generator sets shown are used to supply direct current for operating the municipal electric-railway system of San Francisco, the energy being purchased from the Pacific Gas & Electric Company.

Great Western Power Company

The completion of the hydroelectric station of the Great Western Power Company on the Feather River at Big Bend above Oroville, Cal., marked the beginning of a new era in electric generation and transmission on the Pacific Coast. Prior to that time the typical Western plant received its water through a long wooden flume, and the apparatus was invariably installed in a corrugated-iron house down the canyon. The station of the Great Western Power Company was the first in which the generating equipment was housed in a substantial structure, and from its erection to the present the station has had the distinction of being the largest single power house on the coast. The initial installation at Big Bend consisted of four 10,000-kw units, and

STEAM, WATER-POWER AND ELECTRICAL EQUIPMENTS OF THE GREAT WESTERN POWER COMPANY

GENERATING STATIONS CONNECTED ELECTRICALLY			SUBSTATIONS			SERVICE VOLTAGES	
Location or Name	Rating in Kva	Type (Steam or Hydraulic)	Location or Name of	Transmission, Circuit Mileage at Each Voltage	Companies with Which Connected Electrically	Residence	Industrial
Feather River	50,000	H	Sacramento, Brighton, Isleton, Antioch, Clayton, Oakland, Cowell, Santa Rosa, Napa and Petaluma	308 miles at 100,000 volts	Sells to Half Moon Bay Light & Power Co., Pacific Gas & Electric Co., Western States Gas & Electric Co.; reserve steam plant at Oakland owned by California Electric Generating Company, connected with City Electric Company, San Francisco	110-220 a. c.	110, 220, 440, and 2200 at one, two and three phases, also 500 and 250 d. c., three-wire
Oakland (steam reserve owned by California Electric Generating Co,).	10,500	S					

PRIME MOVERS

Station	No. of Sets	Rating (Each)	R.p.m.	Type	Head (Ft.)	Connection with Generator
Feather River	5	18,000 hp	400	I. P. Morris—Francis	430	Direct
Oakland steam reserve	3	5,000 hp		Five-stage Curtis steam turbines		Direct

STEAM GENERATING EQUIPMENT AT OAKLAND STEAM RESERVE

Fuel		Source of Water for Condensing	Boilers					
Kind	Storage Available		No.	Hp or Effective Heating Surface	Steam Pressure, Lb. per Sq. In.	Superheat (in Deg. Fahr.)	Type	Type of Burners
Fuel oil	10,500 bbl. in main tanks	Sea	6	6000 sq. ft.	225	125	B. & W.	Hamill

Station	HYDRAULIC DETAILS			PROTECTION AGAINST EXCESSIVE HYDRAULIC PRESSURES AND VACUUM		
	Area of Drainage Basin	Topography of Country	Total Water Storage	Type of Equipment	Size or Rating	Location
Feather River	40 sq. mi.	Mountainous	65,000,000,000 cu. ft.	Standpipe	9-ft. dia.	Runs uphill from station about 302 ft. and discharges into spillway

MAIN GENERATORS

Station	No.	Voltage	Phases	Cycles	R.p.m.	Kva (Each)	Type
Feather River	5	11,000	3	60	400	10,000	G. E.
Oakland steam reserve	3	11,000	3	60	.....	3,500	G. E.

EXCITING EQUIPMENT

Station	No.	Voltage	Kw	Type of Drive
Feather River	2	250	250	500-hp horizontal-impulse wheels
Oakland steam reserve	2 1	.....	75 75	Curtis turbine Induction motor

TRANSFORMERS

Station	No.	Kva (Each)	Phases	Voltage		Connections		Type
				Low	High	Low	High	
Feather River	5	10,000	3	11,000	100,000	Δ	Δ	O. I. W. C.

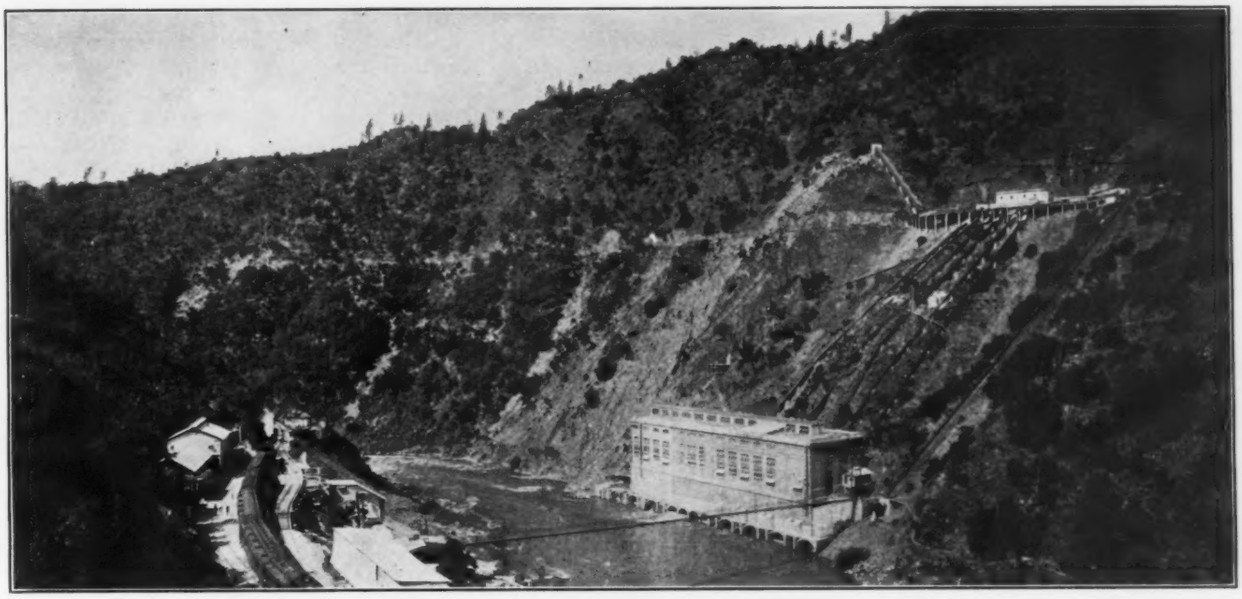


FIG. 26—THE 50,000-KW FEATHER RIVER STATION OF THE GREAT WESTERN POWER COMPANY—THE LARGEST SINGLE PLANT ON THE COAST

during 1913 the foundation substructure was completed for the installation of four additional units. The building was extended 95 ft. so as to house two units, one of which has been installed and is now in operation, making the present rating of the station 50,000 kw. The waterwheels are of the I. P. Morris-Francis type rated at 18,500 hp and operating under an effective head of 435 ft. A complete description of the power plant and of the transmission system was published in the ELECTRICAL WORLD Aug. 26, 1909, and Sept. 16, 1909. The company has a 15,000-hp auxiliary steam station at Oakland (see ELECTRICAL WORLD, Sept. 23, 1909) and a 28,000-hp steam station in San Francisco, so that the company has generating equipment aggregating 105,000 hp.

Since the station was described the company has completed its Big Meadows reservoir, now known as Lake Almanor. This lake contains 250,000 acre-ft. of water, which is available for the generation of electricity at five sites. The stored water, along with the natural flow of the river, is sufficient to assure a continuous output of 70,000 hp from the present station at Big Bend, even through years of most severe drought. The same stored water can be utilized at power sites known as Nos. 4 and 5 under a combined head of 2250 ft., where it will generate 150,000 hp in the dryest season. Power sites Nos. 2 and 3 on the same watercourse will afford 90,000 additional horse-power. Thus the company with its present storage can generate 70,000 continuous horse-power at the switchboard of the Big Bend station, and

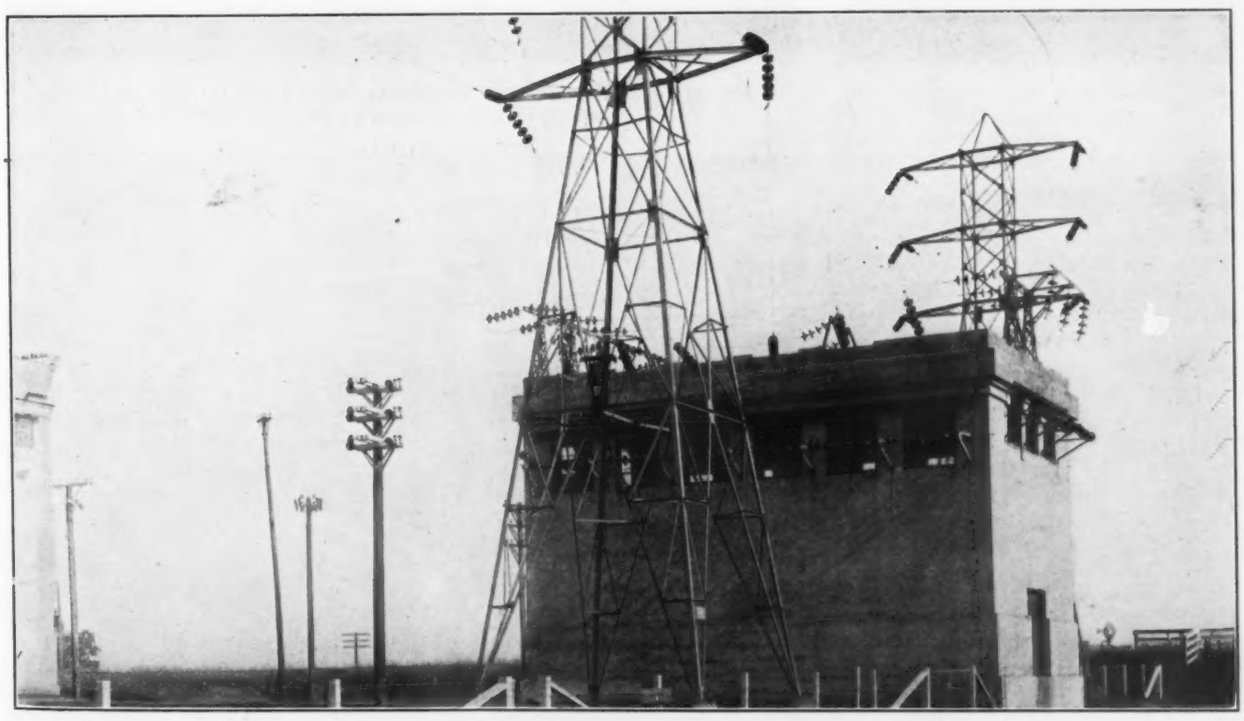


FIG. 27—LINE-SECTIONALIZING STATION AT BRIGHTON, NEAR SACRAMENTO

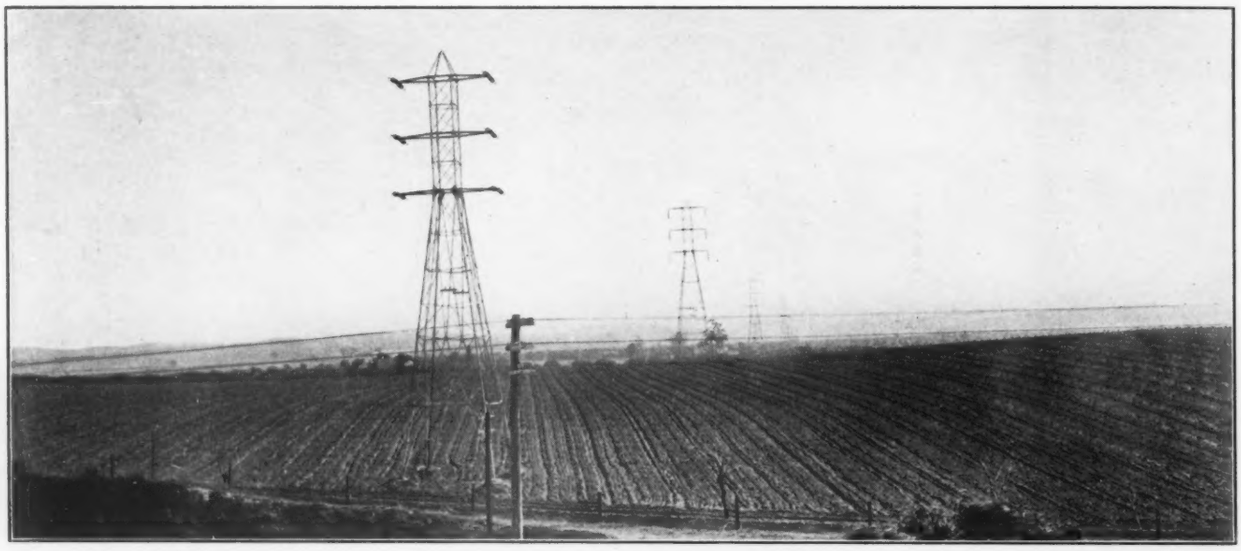


FIG. 28—100,000-VOLT TRANSMISSION LINE OF THE GREAT WESTERN POWER COMPANY, BIG BEND PLANT TO OAKLAND

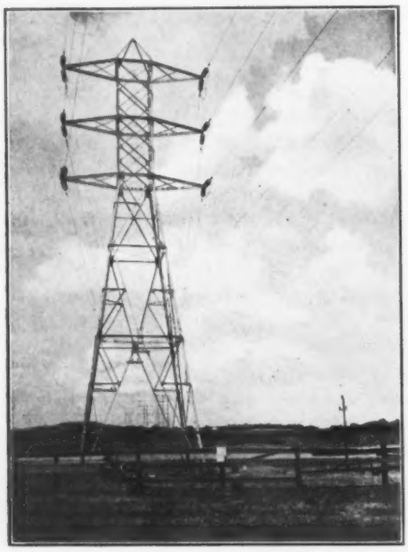


FIG. 29—ANGLE CONSTRUCTION ON 100,000-VOLT LINE

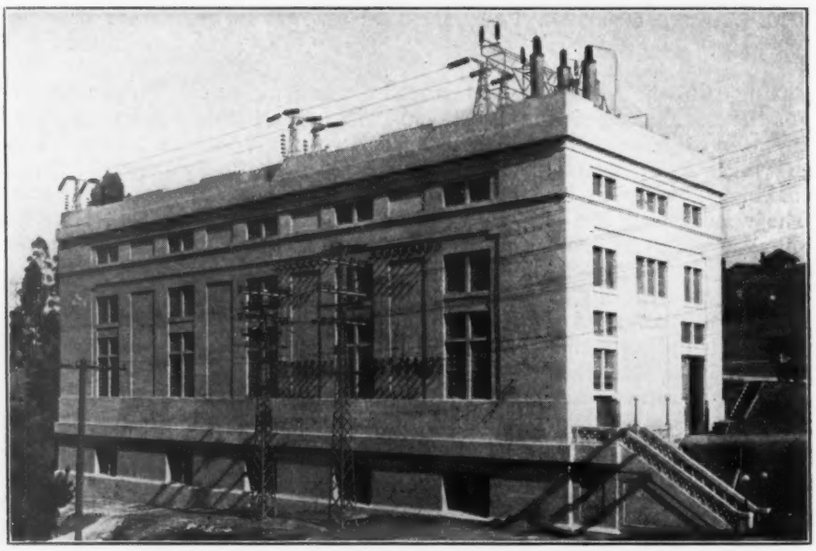


FIG. 30—FOURTH AVENUE TERMINAL SUBSTATION OF THE BIG BEND-OAKLAND LINE

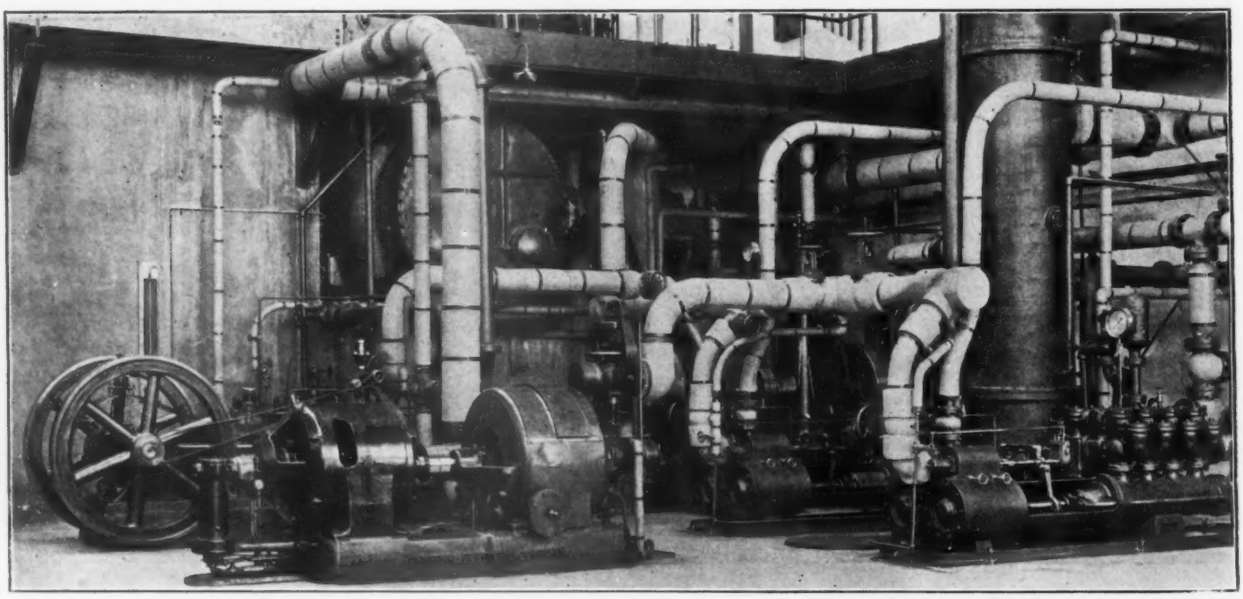


FIG. 31—AUXILIARIES OF ONE OF THE THREE 3750-KW CURTIS TURBO-GENERATORS IN THE OAKLAND STEAM STATION

can equalize the river flow to the extent of making possible the generation of 240,000 additional horse-power at the other sites. Tributary to the Big Meadows reservoir are 504 square miles of watershed, and tributary to the Big Bend station is a drainage area of 2100 square miles. It is the intention to increase the height of the present Big Meadows dam so that it will ultimately impound 1,250,000 acre-ft. of water. The company has thirteen substations, and the transmission system consists of 154 miles of steel-tower line, on which are two three-phase circuits operating at 100,000 volts and extending from the Big Bend station to Oakland by way of the Sacramento Valley. There are 4 miles of submarine cable operating at 11,000 volts, connecting the San Francisco steam station with the hydroelectric station and the Oakland steam station. The Oakland steam station is seldom operated. Views of various parts of the system are reproduced herewith. Last year the Great Western Power Company generated 315,000,000 kw-hr., and the yearly load-factor of the system was 64 per cent.

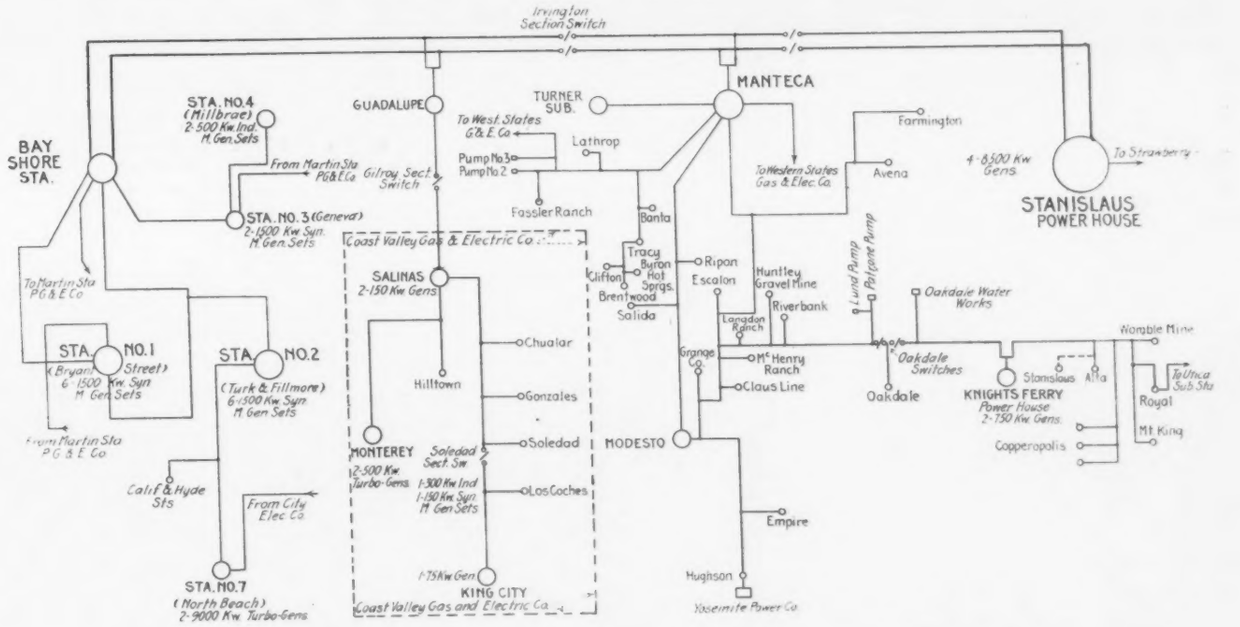


FIG. 32—DIAGRAM OF SYSTEMS OF THE SIERRA & SAN FRANCISCO POWER COMPANY

Sierra & San Francisco Power Company

The Sierra & San Francisco Power Company was incorporated May 29, 1909. Its principal hydroelectric generating station is situated at Stanislaus, where there is an installation of 34,000 kw, which, with forced ventilation, is capable of developing 40,000 kw, although the full development will necessitate an additional penstock. The company owns also a 1875-kw generating plant at Phœnix, near Sonora, and a 1500-kw generating plant at Oakdale. In addition the company possesses a steam generating plant at North Beach, San Francisco, containing steam turbo-generators with an aggregate rating of 18,000 kw.

Water for the Stanislaus hydroelectric plant is taken from the middle fork of the Stanislaus River at a point called Sandbar and carried through approximately 78,000 ft. of wooden flume to the forebay, whence it is dropped through steel penstocks approximately 1500 ft. to the station. Under its water rights the company collects in storage reservoirs the rainfall and melting snows from watersheds, title to which rests generally with the United States government, on the western slope of the Sierra Nevada Mountains. These watersheds have an area of 405 square miles, and the storage reservoirs now constructed will hold 851,000,000 cu. ft. of water. In addition, the company has under construction a storage reservoir at Strawberry, which, when completed, will impound 762,000,000 cu. ft. With the completion of the Strawberry reservoir the company will have available 1,613,000,000 cu. ft. of stored water.

The main transmission line of the company consists of two circuits carried on steel towers from the Stanislaus plant to the Bay Shore substation near the San Francisco city limits, a distance of 136 miles. The rating of these two circuits at 110,000 volts is approximately 40,000 kw. A branch transmission line extends from Port Marion, at the south end of San Francisco Bay, to Salinas, a distance of 73 miles. It is constructed of wood and steel poles and its rating at 57,000 volts is 5000 kw. The main-line transmission substations of the company, with ratings, are as follows: Bay Shore, 30,000 kw; Port Marion, 6000 kw; Salinas, 4000 kw; Manteca, 4500 kw; Stanislaus, 2000 kw. At the Bay Shore substation the voltage is stepped down to 11,000 volts, and at Manteca is situated the main substation for supplying the San Joaquin division, the main-line voltage being stepped down to 30,000 volts and 17,000 volts. Energy at 17,000 volts is furnished from the substation in the Stanislaus plant to the Tuolumne division. Radiating from the Manteca substation the company has 140 miles of 15,000-volt pole lines, distributing energy through numerous substations, principally in San Joaquin and Stanislaus Counties. About 85 miles of 17,000-volt pole lines radiate from the Phœnix power house and distribute energy throughout the Tuolumne territory.

Stanislaus Power House

The main power house is situated on the Tuolumne County side of the Stanislaus River, 2 miles below the junction of the north and the middle forks. It is in the middle of a great bend in a deep canyon 1500 ft. below a rocky rim and 15 miles from Angels' Camp, the latter being on the mother lode in the gold-mining district. The building, a corrugated iron and steel-frame structure, was completed in 1908.

STATIONS OF THE SIERRA & SAN FRANCISCO POWER COMPANY

GENERATING STATIONS CONNECTED ELECTRICALLY

Location or Name	Rating in Kva	Type (Steam, Hydraulic, Internal-Combustion Engine, Etc.)	Date Built
Stanislaus	34,000	H	1908
Phœnix	1,875	H	1902
Knights Ferry	1,500	H	1899
San Francisco	.....	....	Rebuilt
North Beach	18,000	S	1910
Bryant	3,200	S	1893

PRIMARY SUBSTATIONS[1]

Location or Name	Rating in Kva	Date Built or Rebuilt	Counties Served
Manteca	6,750	1912	San Joaquin
Port Marion	6,000	1912	Santa Clara
Bay Shore	22,500	1912	San Mateo
Salinas	1,500		Monterey

[1] Secondary substations in San Francisco, Tuolumne, Calaveras, San Joaquin, Stanislaus and Contra Costa Counties.

HYDRAULIC DETAILS

Station	Area of Drainage Basin	Topography of Country	Flow of Water Available in Second-ft.			Total Water Storage
			Average	Maximum	Minimum	
Stanislaus	338 sq. miles above diverting dam	Mountainous	932	3560	75 without storage	650,000,000 cu. ft. behind 140-ft. relief dam from winter run-off, 1,500,000 cu. ft. behind 20-ft. diverting dam.
Phœnix	67 sq. miles	Mountainous	27	50	1	243,560,000 cu. ft. at present. Dam under construction at Lower Strawberry will increase storage by 727,887,000 cu. ft.
Knights Ferry		Mountainous				Has benefit of storage in forebay at Stanislaus.

DAM DETAILS

Station	Location	Height	Material	Type	Length Along Crest in Ft.	Method of Increasing Head	Dimensions of Spillway
Stanislaus	45 miles above station on middle fork of Stanislaus River	140 ft.	Rock fill with concrete apron	Loose fill derrick-laid	525	5-ft. flashboards	29.5 ft. by 10 ft.
Phœnix	Restraining dams at Lower Strawberry, Big Dam, Middle Dam, Herring Creek, and Lyons	45 50 50 50 50	Log			None	
Knights Ferry		50	Rock-fill concrete	Crib concrete	138 90	None	

FOREBAY

Station	Storage Available	Head in Ft.	Method of Increasing Head	Spillway Dimensions
Stanislaus	14,000,000 cu. ft.	1500	None	25 ft. by 2.73 ft.
Phœnix	None	1000	.....	.....
Knights Ferry	.....	134	.....	.....

PROTECTION AGAINST EXCESSIVE HYDRAULIC PRESSURES AND VACUUM

Type of Equipment	Size or Rating	Location
Two standpipes	40 ft.	Near junction of steel and wood pipes
Six air valves	6 in. dia.	On wood-stave section
Eight air valves	6 in. dia.	On steel section
Five air valves	.....	In pipe line
Four air valves	.....	.....
One stand pipe	8 in.	.....

PRIME MOVERS

Station	No. of Sets	Hp (Each)	R.p.m.	Horizontal or Vertical	Type	Connection with Generator	Governor (Type)
Stanislaus	4	12,000 per pair	400	H	Pelton waterwheel	Direct double overhung	Pelton oil-pressure pilot-control and safety levers
Phœnix	3	500	400	H	Pelton waterwheel	Direct	None
	1	1000	333	H	Pelton waterwheel	Direct	Lombard control
Knights Ferry	2	387	400	H	Pelton waterwheel	Direct	Lombard
	2	387	900	H	Victor waterwheel	Rope drive	Lombard
North Beach	2	18,000 kw (total)	720	V	Five-stage Curtis steam turbines	Direct	

STEAM AND ELECTRIC EQUIPMENTS OF THE SIERRA & SAN FRANCISCO POWER COMPANY

STEAM GENERATING EQUIPMENT

Station	Boilers						Grates		Nozzles		
	No.	Hp	Type	Steam Pressure, Lb. per Sq. In.	Superheat (in Deg. Fahr.)	Facilities for Raising Steam Quickly	Area per Boiler	Type	No.	Arrangement	Type
North Beach	18	10,300 (total)	B.&W.	200	40	Keep boilers warm	1000 sq. in.	Brick checker work	....	.....	.....

Station	Fuel						
	Kind	Heating Value	Ash Content	Average Cost at Plant	Storage Space Available	Method of Storing	Facilities for Receiving
North Beach	Crude oil	18,000 lb.-Fahr. units per lb.	None	.....	30,000 bbl., enough for twenty days with plant operating full load	Covered steel tank	By water

MAIN GENERATORS

Station	No.	Voltage	Phases	Cycles	R.p.m.	Kva (Each)	Type	Method of		Are Air Filters or Coolers Used?	Rating of Generator Reactors
								Grounding Windings	Ventilating		
Stanislaus	4	4,000	3	60	400	8500	General El.	None	Two separate fans rated at 60,000 cu. ft. each	No, as air is taken from over tailraces at about 15 deg. C.	None
Phœnix	1 3	2,400 2,400	3 3	60 60	333 400	750 375	G. E. Stanley			None	None
Knights Ferry	2	500	2	60	400	750	West. R. C.	None		None	None
North Beach	2	12,000	3	60	720	9000	G. E.		Suction system	None	None

EXCITING EQUIPMENT

Station	Generators					Drive		Miscellaneous
	No.	Voltage	R.p.m.	Kw	Type	Type	Hp	Voltage Regulators
Stanislaus	1 1	250 250	720 720	300 300	G. E. G. E.	Single overhung Pelton waterwheel G. E. waterwheel	600 400	Tirrill
Phœnix	2 1	60 60	1000 750	15 15	Eddy G. E.	Waterwheel		None
Knights Ferry	1 1	125 125	1200 1200	11.25 8.5	Westinghouse Edison	Victor waterwheel Sampson waterwheel	15 10	None
North Beach	1 1 1	125 125 125	150 720 2400	75 200 125	G. E. G. E. G. E.	Union Iron Works motor G. E. engine Curtis turbine	300	None

Station	Transformers									Miscellaneous	
	No.	Kva (Each)	Phases	Voltage		Connections		Type	Service	Protection Against Static Strains	Type of Oil Filter
				Low	High	Low	High				
Stanislaus	12	2233	1	4000	104,000	Δ	Y	G. E. O-I. W. C. indoor	Feed transmission	High-voltage neutral grounded direct	General Electric portable filters
Phœnix	8	150	1	2300	15,000	Δ	Δ	Stanley O-I. W. C. indoor	Feed transmission	See "Protective Equipment"	None
Knights Ferry	2	375	2 to 3	500	15,000	2 Ph.	T	Westinghouse O-I. S.C. indoor	Feed transmission	Do.	None
North Beach	Use none; generate at 11,000 volts and deliver to system at same pressure									Do.	None

TRANSMITTING AND DISTRIBUTING CIRCUITS OF THE SIERRA & SAN FRANCISCO POWER COMPANY

LOW-VOLTAGE BUSBARS, SWITCHES, ETC.

Station	Busbars		Switches		Rating of Reactors		Miscellaneous
	No. of Sets	Arrangement	Type	Rating (Each)	Busbars	Feeders	Are Overload, Reverse-Power, Differential Relays, etc., Employed?
Stanislaus	2	Loop, vertical	G. E. Form H3	1200 amp	None	None	Ground-indicating relays in grounded neutral of 104,000-volt lines
Phœnix	2	Loop, vertical	None		None	None	None
Knights Ferry	2	Loop	None		None	None	None
North Beach	See High-voltage Busbars, Switches, etc.						G. E. overload time-limit relays

HIGH-VOLTAGE BUSBARS, SWITCHES, ETC.

Station	Busbars				Switches		Type of Protective Equipment
	No. of Sets	Arrangement	Material	Method of Supporting	Type	Rating	
Stanislaus	.....	Sectionalized with disconnecting switches	0.75-in. hollow copper tube	From suspension insulators	Type T G. E. oil-immersed air-operated electric control	114.000 volts	G. E. single-pole aluminum-cell lightning arresters on outgoing lines
Phœnix	.....	Sectionalized with disconnecting switches	No. 4 wire	In vertical plane	P. E. Mfg. Co. air-break T. P. S. T.	300 amp 33,000 volts	Stanley lightning arresters
Knights Ferry	.....	Sectionalized with air-break switches	No. 4 wire	On pin insulators	Air-break switches but no oil switches	.....	Choke coils
North Beach	.....	Sectionalized with disconnecting switches	0.375-in. by 2-in. copper straps	On studs	G. E. H3 oil switches	300,500 and 800 amp	Overload time-limit relays

TRANSMISSION	DISTRIBUTION	
	Circuit Mileage	
Circuit Mileage at Each Voltage	Overhead	Underground
104,000 volts, 274 miles 55,000 volts, 74 miles	17,000 volts, 268 miles 11,000 volts, 34 miles Below 11,000 volts, 249 miles	9 miles

TRANSMISSION SYSTEM

Station	Termini	Length in Miles	Topography of Route	Conditions Subjected to	Maximum Elevation Above Sea Level in Ft.	No. and Spacing of Sectionalizing Stations	Provision for Future Circuits	Width of Right-of-Way
Stanislaus	Double-circuit 104,000-volt line from Stanislaus to Bay Shore substation	137	50 miles mountainous 55 miles flat dry 32 miles marshland Parallels railroad Manteca to Bay Shore	High winds, fogs, snow and lightning	3000	At Manteca 53 miles from Stanislaus and at Port Marion 52 miles from Manteca	Contemplate line from Stanislaus to Mission San José, 98 miles, and thence to Bay Shore	60 ft.
	55,000-volt line from Port Marion to Salinas	73	59 miles flat 14 miles hilly Parallels railroad nearly entire distance					
Phœnix	Phœnix to Altaville and Jacksonville at 17,000 volts	26	Mountainous	Lightning and high winds	3000	Various outdoor section switches	None	For poles only
Knights Ferry	Knights Ferry connected with a 17,000-volt system extending northeast and southwest	.....	.....	.....	.....	.....	.....	.....
North Beach	11,000-volt distribution system to substations of United Railroads of San Francisco for standby service	8.4 to Bay Shore	.....	.....	200	All substations serve as sectionalizing stations	Existing overhead and underground system allows for enlargement	Practically all on city streets

CIRCUITS AND SERVICE OF THE SIERRA & SAN FRANCISCO POWER COMPANY

TOWERS AND POLES

Station	Service	Height in Ft.		Spacing in Ft.		Ground Clearance in Ft. with		Type	No. of Circuits per Tower	Arrangement of Conductors	Spacing in Ft.	Position of Ground Wires
		Normal	Maximum	c Normal	d Maximum	c	d					
Stanislaus	Standard 104,000-volt towers	74	195	800	1800	32	25	Four-section cross-girded steel windmill	2	Two vertical planes	9	None
	Standard 55,000-volt poles	60	.....	300	450	25	25	.....	1	Vertical	6.5	None
	Special	74	.....	800	2400	32	25	Windmill and flexible	1	Vertical	9	None
Phœnix	Standard	30	40	200	750	27	27	.....	.....	.....	.....	.....
Knights Ferry	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
North Beach	Distribution poles	44	53	100	.....	32	....	Cedar poles	1 to 6 per pole	Triangular	26 in.	None

	CONDUCTORS				INSULATORS		
Station	Route	Material and Cross-section	No. of Strands	Material of Core	Service	No. of Sections	Type
Stanislaus	Stanislaus to Bay Shore	No. 00 copper	6	Hemp	Standard	5 7	Victor 273 Locke 2335
	Port Marion to Salinas	Aluminum (equivalent to No. 1 copper) and No. 1 copper	6 6	Steel Hemp	Anchor	5	Victor 273
Phœnix	Phœnix to Jacksonville	Nos. 4 and 6 copper	Solid	.....	Standard Special	....	Locke White No. 3 Locke 408 A
Knights Ferry	.....	.....	.....	.....	.....	.....	.....
North Beach	Underground Overhead	No. 0000 copper 350,000-circ. mil copper cables	37 Solid	.....	Standard	1	Locke 408A pin

CHARACTERISTICS OF SERVICE

Character of Load	Total Connected Load		Maximum Combined Peak		Distribution of Energy Last Year in Kw-hr		
	Lighting	Industrial	Kw	Date	Generated	Purchased	Sold for Distribution
Railway, industrial and lighting	2000 kw	65,000 hp	40,080	Jan. 16, 1914	144,892,960	34,552,000	14,121,394

SERVICE VOLTAGES			TERRITORY SERVED		
Residence	Industrial	Railways	Area	Population of District	No. Consumers Served
110 a. c.	2300 a. c. 440 a. c. 220 a. c. 110 a. c.	340 a. c. 2,300 a. c. 11,000 a. c.	1396 sq. mi.	512,828	3717

MISCELLANEOUS

Total Investment in System	Gross Annual Income	Total Hours Operating Annually	Companies with Which Connected Electrically
$11,385,613, including water system	$1,082,065.28 from sale of electricity for year ended Dec. 31, 1914	8760	Pacific Gas & Electric Co., Western States Gas & Electric Co., United Railroads of San Francisco, Coast Valleys Gas & Electric Co., and some small companies

Three branch pipes from the power-house header further branch so as to feed eight Pelton waterwheels, two to a generator, overhung on the same shaft, one wheel on each side of the generator. The static head is 1490 ft., and the penstocks were designed for a 5 per cent loss. When delivering 20,000 kw actual test showed the loss to be a little less than 5 per cent. The maximum capacity of the penstocks by actual test is 33,000 kw. Each of the eight supply pipes is equipped with a 20-in. Pelton gate valve, gear and worm wheel for hand operation and reversible Pelton motor for automatic operation. Each of the Pelton impulse wheels is rated at 6000-hp maximum overload and was tested to 12,000-hp output.

Oil-pressure governors actuate the nozzle deflection, and the movement of the needle for regulating the area of the opening is controlled by a hand wheel. The governors are of the Pelton type and have individual oil pumps and separate pressure and discharge tanks. Synchronizing motors and connections permit speed control from the switchboard. There are Pelton safety levers on the governors for automatically shutting down the units in case of accident to governors.

The electrical equipment consists of four 8500-kw generators (which can be raised to 10,000 kw each by forced ventilation). These are eighteen-pole, 400-r.p.m., three-phase, sixty-cycle, 4000-volt machines. Twelve transformers step up the potential to 104,000 volts for delivery to two main transmission lines to Bay Shore substation. The transformers are connected "Y," with grounded neutral. Two 300-kw, 250-volt, 720-r.p.m. exciters, one driven by a waterwheel and the other by an induction motor, are provided. Aluminum-cell lightning arresters are connected on the outgoing 104-kv lines, and also on the 4000-volt secondary leads to the transformers. Multiple-gap lightning arresters are connected on the outgoing 17,000-volt lines.

In the south end of the station there is one bank of three 500-kw transformers that feed into the Tuolumne division at 17,000 volts, and a bank of three 250-kw transformers that feed a 17,000-volt line 30 miles long to Strawberry Dam, where the energy is used for the construction of a large storage dam on the headwaters of the middle fork of the Stanislaus River.

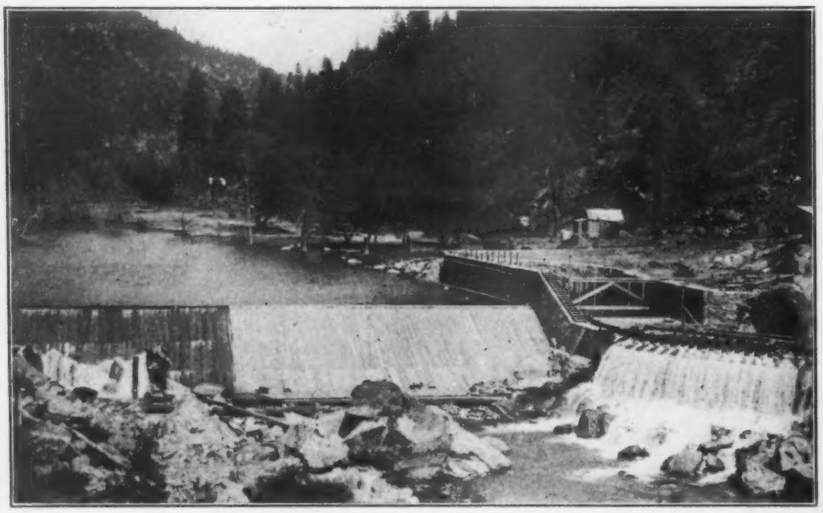


FIG. 33—SAND-BAR DAM—HEADGATES, SPILLWAY AND FLUME AT THE RIGHT

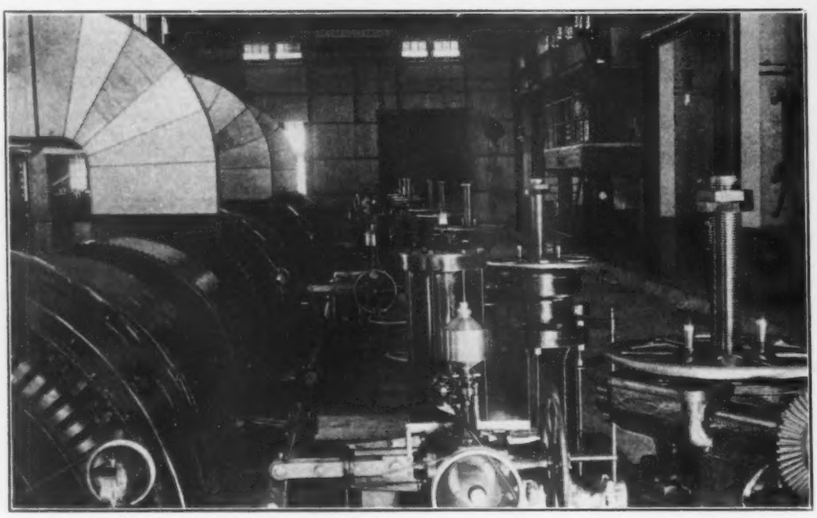


FIG. 34—GENERATORS IN STANISLAUS PLANT, RAISED TO 10,000-KW RATING BY SPECIAL VENTILATING EQUIPMENT

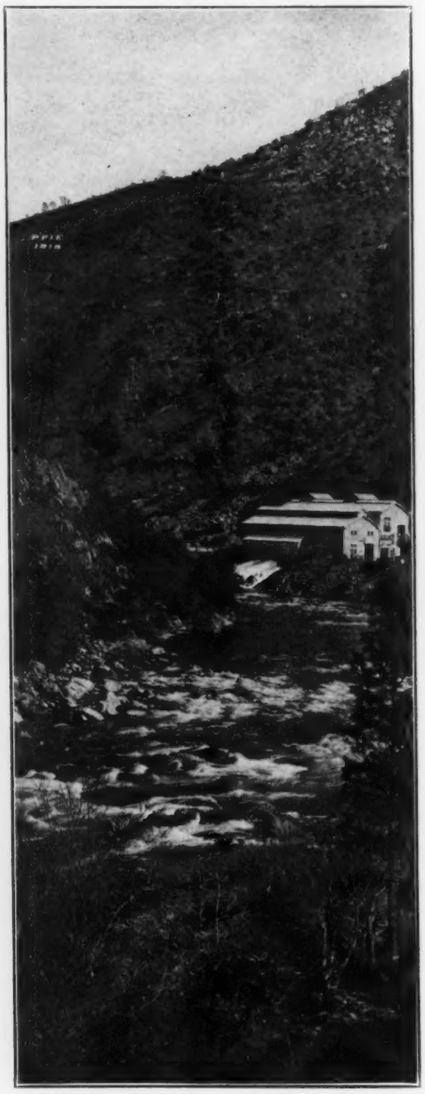


FIG. 35—STANISLAUS PLANT, SIERRA & SAN FRANCISCO POWER COMPANY

Transmission Line

The 104,000-volt transmission line is 138 miles long. It extends from the power house on the Stanislaus River in the Sierra Nevada Mountains straight across the San Joaquin Valley, around San Francisco Bay and up the peninsula to Bay Shore substation. It crosses the Stanislaus River near the power house and traverses

Calaveras, San Joaquin, Alameda, Santa Clara and San Mateo Counties, over mountains, plains, valleys and marsh lands. The line consists of a series of long tangents and is supported on towers throughout, except the 57,000-volt branch line from Port Marion to Salinas, which consists of towers, A-frames and poles.

The tower spans average 850 ft., the maximum span approximating 1925 ft. The towers are of galvanized iron, four columns, square and diagonally braced. In height they vary from 35 ft. to 50 ft. from ground to the lower cross-arm. Valley towers are somewhat higher than mountain towers, and the minimum clearance of wires is 25 ft. One single-circuit tower line and a double-circuit tower line with one circuit on at present go as far as Mission San José, where the two circuits continue on one tower line to San Francisco. The wire is of No. 00 copper cable, six-strand, hemp-core, and is completely transposed every 10 miles. The minimum distance between wires is 96 in. Five-element suspension insulators are used. Across the marshes at the lower end of San Francisco Bay the towers were placed on piles with concrete-cap foundations, and the spans approximate 800 ft. in length.

FIG. 36—TRANSMISSION LINE OF SIERRA COMPANY

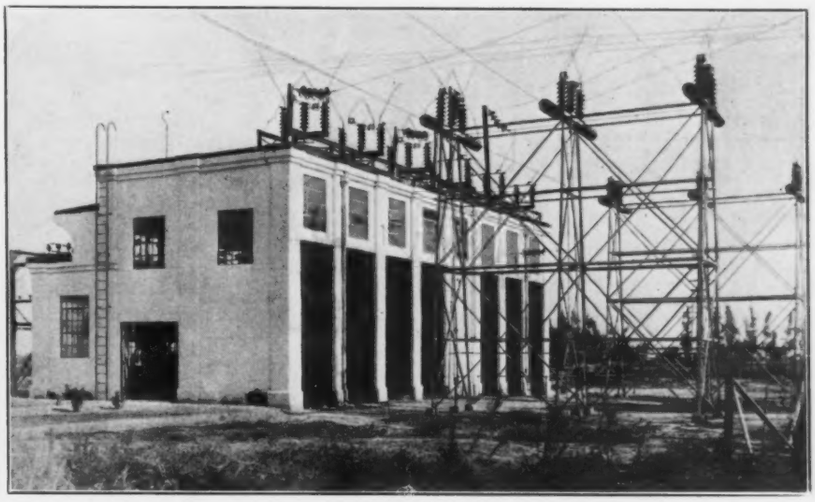


FIG. 37—HIGH-TENSION ENTRIES TO MANTECA SUBSTATION, SIERRA & SAN FRANCISCO POWER COMPANY

A telephone line of No. 12 N. B. S. copper wire on separate poles parallels the transmission line 137 miles as far as Mayfield, and a leased line is employed from Mayfield to San Francisco. The length of the telephone line is greater than the tower line, because it follows a more irregular route. The 57,000-volt branch line from Port Marion to Salinas has a private telephone line on the same poles and towers, but owing to the close proximity of this and other high-tension lines it has never given very satisfactory service.

Bay Shore Substation

The Bay Shore substation is situated at the San Francisco end of the transmission line, just south of the city limits. At present it contains seven 3750-kw standard oil-filled, water-cooled, 104,000-volt, sixty-cycle transformers connected grounded star on the high-tension side and delta on the low-tension side. The transformers are 17 ft. high and are placed in separate compartments. Each unit weighs 28 tons, takes 3100 gal. of oil, and requires 20 gal. water per minute.

The 12,000-volt secondary lines go to the North Beach steam turbine plant and to Turk and Fillmore, Bryant Street, Geneva Avenue, and Millbrae substations, where the electricity is converted into direct current for the local street-car system and a small industrial load. There is also a 400-kw, two-phase rotary converter in the station feeding some street-car lines in the neighborhood.

North Beach Steam Auxiliary Station

The North Beach steam station is situated on the northern side of San Francisco and formerly contained reciprocating steam engines. The present generating equipment comprises two 9000-kw, 12,000-volt Curtis vertical steam turbo-generators. Steam is supplied by eighteen B. & W. boilers, aggregating 10,300 boiler-hp and fitted with complete fuel-oil-burning apparatus. A Worthington and a Wheeler condenser are used, water being taken from the bay. The station has all other necessary auxiliary apparatus.

At one end of the building is a substation of the Pacific Gas & Electric Company, from which energy is delivered to the distribution circuits of the Panama-Pacific International Exposition.

Distributing Systems

The four distributing systems are as follows: Tuolumne Division, San Joaquin Division, San Francisco Division, and Santa Clara Division.

The Tuolumne Division operates in the Sierra Nevada Mountains, obtaining energy from three 500-kw transformers installed in one end of the Stanislaus power house. Energy is delivered to the towns of Tuolumne, Sonora and Jamestown, and for operating all the mines of that section of the mother lode. The company also supplies water for mining, irrigation, domestic use, etc., in the above section.

The San Joaquin Division, with headquarters at Modesto, comprises an area of 707 square miles in the fertile San Joaquin Valley between Stockton and Modesto. The division is fed by four 17,000-volt lines and two 4000-volt lines from Manteca substation, the latter serving the territory within a radius of 4 miles of the substation. One of the 17,000-volt lines is connected at Knight's Ferry with the Tuolumne Division, so that an exchange of energy may be made if necessary. The principal towns served are Stockton (through Western States Gas & Electric Company), Modesto, Tracy, Lathrop, Oakdale, Riverbank, Byron, Ripon, Escalon, etc. Interchange of energy can also be made at Modesto substation with the Yosemite Power Company.

The San Francisco Division is fed by six 12,000-volt

lines going from the Bay Shore substation, supplying energy in conjunction with the North Beach auxiliary steam plant to four substations for conversion to direct current for operating the United Railways of San Francisco and supplying a small industrial load.

The Santa Clara Division is fed by the 57,000-volt line running from Port Marion southward 73.5 miles to Salinas, where the energy is delivered to the Coast Valleys Gas & Electric Company at its Salinas substation. From there a 57,000-volt line (now operated at 30,000 volts) continues through the towns of Chuler, Gonzales, Soledad, Los Coches and King City. Another line of 22,000 volts goes from Salinas through Hilltown to Monterey. There are substations in these various towns, and the load comprises domestic, railway and municipal service and a heavy irrigation load. This service is entirely in Monterey County.

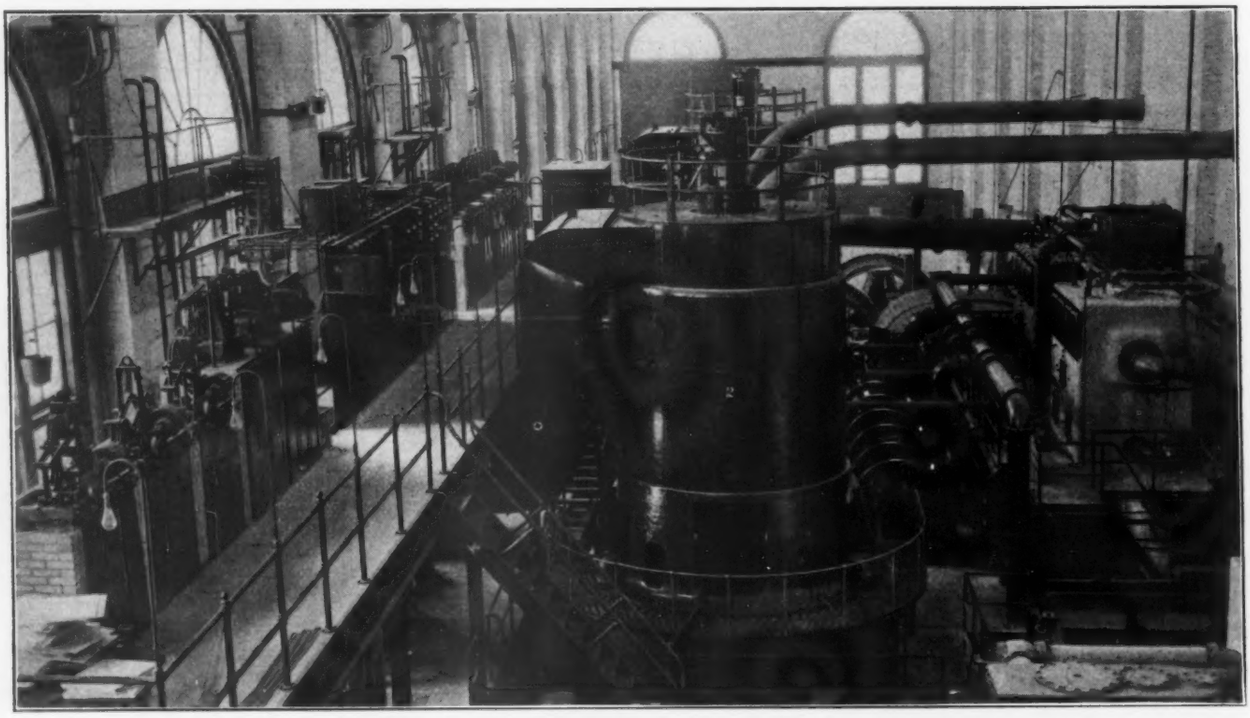


FIG. 38—NORTH BEACH STEAM PLANT ADJOINING SAN FRANCISCO EXPOSITION GROUNDS

Last year the Sierra & San Francisco Power Company generated 179,444,960 kw-hr., and the load-factor of its system was 51.2 per cent.

Northern California Power Company

The hydroelectric developments of the Northern California Power Company are situated on Battle Creek and Old Cow Creek. The principal source of water supply is the western slope of Mount Lassen, for many years a snow-capped peak but at present an active volcano, belching forth lava and gases.

The company operates seven hydroelectric plants with a combined rating of 50,000 hp, water-works at Redding and Willows, and gas works at Redding, Red Bluff and Willows. The company on Dec. 31, 1914, also operated forty-six substations. It supplies light to all important towns in Shasta, Tehama and Glenn Counties, Cal., and has a contract expiring December, 1925, to deliver 10,667 hp to the Pacific Gas & Electric Company at Chico, Cal., where connection is made with that company's lines. Location of plants: Volta, Shasta County, Cal. (9000 hp); Kilare, Shasta County, Cal. (4000 hp); South Power House, Tehama County, Cal. (6000 hp); Inskip, Tehama County, Cal. (8000 hp); South Cow Creek (2500 hp); Snow Creek (1500 hp), and Coleman, Shasta County, Cal. (20,000 hp). Gas is manufactured and distributed in Redding, Red Bluff and Willows, and water is distributed for municipal and domestic uses in Redding and Willows. Franchises are without limitation in point of time in the cities; county franchises for the use of public highways for transmission lines extend to from 1952 to 1956.

The Coleman plant, which is the largest and most important of the company's stations, was described in the ELECTRICAL WORLD Feb. 3, 1912.

Energy is transmitted at 22,000 volts and at 66,000 volts. The first type of transmission line follows closely the practice of fifteen years ago, solid copper wire being run on 30-ft. wooden poles and insulated by triple-petticoat glass insulators. The higher voltage lines are mounted on wooden poles with porcelain insulators. Except for a few places near towns roads are not followed by the transmission lines.

The substations on the company's system are situated chiefly in the upper Sacramento Valley. At Chico the system of the Northern California Power Company is tied in with the system of the Pacific Gas & Electric Company, the substation containing merely the necessary line switches and instruments for measuring the energy. There are approximately 260 miles of 22,000-volt lines and 126 miles of 66,000-volt lines. The company also sells a block of power to the Oro Electric Corporation. Recently the action of the government in shutting down a number of copper smelters because the fumes destroyed vegetation has deprived the Northern California company of a considerable portion of its mining load. This loss was further accentuated when the European war broke out and copper producers curtailed production. Some of the companies connected with the Northern California Power Company's circuits suspended operations entirely.

In December, 1914, the company was serving 6301 customers with electricity and had a load of 39,853 hp connected to its system, In its last report the company made the following comparison of its operating costs

WATER-POWER EQUIPMENT OF THE NORTHERN CALIFORNIA POWER COMPANY

HYDRAULIC DETAILS

Station	Area of Drainage Basin, Square Miles	Topography of Country	Flow of Water Available in Second-Feet			Total Water Storage
			Average	Maximum	Minimum	
South	170	Mountainous	85	Flood	79	Storage reservoirs affecting Volta plant affect this plant
Volta	85	Mountainous	100	500 (est.)	79	3306.97 acre-ft., sufficient for 85,000 hp-hr.
Kilare	60	Mountainous	50	100	22	400 acre-ft.
South Cow Creek	80	Mountainous	20	Flood	10	
Inskip	250	Mountainous	300	1000	177	Storage reservoirs affecting Volta plant affect this plant
Coleman	Over 300	Foothills	350	Flood	250	Storage for three other plants used for this plant

DAM DETAILS

Station	Location	Height (in Ft.)	Material	Type	Length Along Crest in Ft.	Method of Increasing Head	Dimensions of Spillway
South	South Battle Creek North Battle Creek	5 5	2-in. planks and heavy timbers 2-in. planks and heavy timbers	..... Timber crib	80 60	None None	....
Volta	North Battle Creek Macomber	46 28	Cyclopean masonry Hand-placed rock with water-tight cyclopean masonry front	..... Flat	426 160	None None	18 ft. long 22 ft. long
Kilare	Canyon Creek North Cow Creek	5 7	Masonry Masonry	Straight wall Overflow	30 16	None None	....
South Cow Creek	.....	....	.....	.....	.....	.....	.....
Inskip	South Battle Creek North Battle Creek	45 15	Masonry 2-in. planks supported by heavy timbers	Overflow Timber crib	100 70	None None	....
Coleman	South Battle Creek	16	Masonry	Straight, gravity section	110	None	110

Station	FOREBAY				PROTECTION AGAINST EXCESSIVE HYDRAULIC PRESSURES AND VACUUM		
	Storage Available	Head in Feet	Method of Increasing Head	Spillway Dimensions	Type of Equipment	Size or Rating	Location
South	7500 cu. ft.	516	None	35 ft. wide	.....	.....	.....
Volta	20 acre-ft.—148 acre-ft.	1250	None	3 ft.x5 ft.—6 ft.x8 ft.	Vertical surge pipe	Height, 81 ft.—Diam. 30 in.	4500 ft. from power house
Kilare	56 acre-ft.	1192	None	16 ft.x1 ft.	.....	.....	.....
So. Cow Creek	10 acre-ft.	726	None	16 ft.x8 ft.	.....	.....	.....
Inskip	10,800 cu. ft.	.....	None	.....	Standpipe	Height 35 ft.—Diam. 20 in.	1890 ft. from power house
Coleman	.....	487	None	.....	Allis-Chalmers	36 in.	Discharge side of turbines
					Standpipe	86 ft.x24 in.	Stand pipe on each pipe line

PRIME MOVERS

Station	No. of Sets	Hp (Each)	R.p.m.	Horizontal or Vertical	Type	Connection with Generator	Governor (Type)
South	2	4000	225	Horizontal	Doble	One wheel on each end of generator shaft	Lombard
Volta	3	1500	400	Horizontal	Pelton	Directly connected, also arranged to operate adjacent unit	Three Lombard type F
	1	4000	300	Horizontal	Pelton	Directly connected	Lombard type N
	1	4000	300	Horizontal	Doble	Directly connected	Lombard type Q
Kilare	4	2000	300	Horizontal	Pelton	One wheel on each end of two generator shafts	Lombard
South Cow Creek	2	1500	600	Horizontal	Pelton Impulse	Directly connected	Pelton
Inskip	3	7000	225	Horizontal	Pelton	Three wheels on each shaft. Two nozzles on each wheel on larger unit	Lombard type Q
	3	3500	225	Horizontal	Pelton		Lombard type Q
Coleman	3	7000	450	Horizontal	Francis	Directly connected	Oil-operated

ELECTRICAL EQUIPMENT OF THE NORTHERN CALIFORNIA POWER COMPANY

MAIN GENERATORS

Station	No.	Voltage	Phases	Cycles	R.p.m.	Kva (Each)	Type	Method of	
								Grounding Windings	Ventilating
South	1	6600	3	60	225	4000	Westinghouse	.....	.....
Volta	3 1 1	500 2200 2200	3 3 3	60 60 60	400 300 300	750 2000 2000	Westinghouse Westinghouse General Electric	.....	Vacuum from tailrace draws heated air from generators
Kilare	2	2200	3	60	300	1500	Westinghouse	Not grounded	.....
South Cow Creek	2	2300	3	60	600	750	General Electric	Not grounded	.....
Inskip	1 1	6600 6600	3 3	60 60	225 225	4000 2000	Westinghouse	Not grounded	7000-cu. ft. belt-driven exhaust fan in 20-in. draft tube
Coleman	3	6600	3	60	450	5000	Allis-Chalmers	Not grounded	Fans on both ends of rotors

LOW-VOLTAGE BUSBARS, SWITCHES, ETC.

Station	Busbars		Switches	
	Number of Sets	Arrangement	Type	Rating (Each)
South	1	.....	E Westinghouse oil	7500 volts, 400 amp
Volta	2	Parallel	D Westinghouse oil	3500 volts, 600 amp
Kilare	2	Parallel	D Westinghouse oil	3500 volts, 400 amp
South Cow Creek	2	Parallel loop connected	F General Electric oil	Two 2500 volts, 300 amp. One 2500 volts, 600 amp
Inskip	2	Parallel	E Westinghouse oil	7500 volts, 400 amp
Coleman	3	Transfer bus used	F General Electric oil	7500 volts, 800 amp

HIGH-VOLTAGE BUSBARS, SWITCHES, ETC.

Station	Busbars			Switches		Protective Equipment
	Arrangement	Material	Method of Supporting	Type	Rating	Type
South	.....	.....	.....	Kelman oil	75,000 volts, 300 amp	Northern Calif. Co. horn-gap choke coils
Volta	Busbars sectionalized by 20-kv Cal. El. air and 60-kv knife switches	Nos. 4 and 2 copper	20-kv and 60-kv pin insulators	Kelman oil	75,000 volts, 300 amp	N. C. P. Co. horn-gap, choke coils
Kilare	Busbars sectionalized by knife switches on post insulators	Solid No. 4 copper	40-kv pin insulator	Pacific Elect. Baum tub	40,000 volts, 150 amp	Westinghouse low equivalent
So. Cow Creek	.....	No. 2 copper	Pin insulators		.....	.....
Inskip	Sectionalized by knife switches on Locke insulators	No. 1 solid copper	Pin insulators	Kelman oil	75,000 volts, 300 amp	N. C. P. Co. horn-gap with choke coils on lines
Coleman	Sectionalized by knife switches on post insulators	0.5 in. brass tubes	Suspension insulators	G. E. oil type F	75,000 volts, 100 amp	No. 675 Locke for outlets

Station	Transformers							Miscellaneous
	No.	Kva Each	Phases	Voltage		Connections		Type	Protection Against Static Strains
				Low	High	Low	High		
South	3	1500	1	6,600	38,100Δ 66,000Y	Δ	Y	G. E. O.-I. W.-C. Indoor	Neutral grounded directly
Volta	9 4 6	300 1250 875	1 1 1	500 20,000 2,200	20,000 66,000 38,000	Δ Y Δ	Δ Y Y	West. O.-I. West. O.-I. W.-C. G. E. O.-I. W.-C.	Neutral connected with regulator, permitting 10 per cent buck or boost
Kilare	7	625	1	2,200	22,000	Δ	Δ	West. O.-I. O.-C. Indoor	
South Cow Creek	3	550	1	2,300	38,100Δ 66,000Y	Δ	Y	G. E. O.-I. W.-C. Indoor	
Inskip	6	1500	1	6,600	38,100Δ 66,000Y	Δ	Y	G. E. O.-I. W.-C. Indoor	Neutral grounded directly
Coleman	4	4000	3	6,600	38,100Δ 66,000Y	Δ	Y	G. E. O.-I. W.-C. Indoor	

TRANSMISSION SYSTEM OF THE NORTHERN CALIFORNIA POWER COMPANY

TRANSMISSION SYSTEM

Station	Termini	Circuit Miles	Topography of Route	Conditions Subjected to	Maximum Elevation Above Sea Level in Ft.	No. and Spacing of Sectionalizing Stations	Provision for Future Circuits	Width of Right-of-Way in Ft.
South	To: Volta, Inskip	11.5	Mountains	High winds and lightning	1900	.....	.....	60
Volta	To: Palo Cedro, South, Inskip, Kilare	115 miles of 60-kv line, 16 miles of 20-kv line	Mountains	Snow, high winds and lightning	2200	One at Molinas 41 miles from Volta	.....	60
Kilare	To: Volta, Kennett	48 (total)	Mountains	Do.	3700 3300	One at Bully Hill 20 miles from Kilare	None	60
So. Cow Creek	Chico	95 (total)	Mountains	High winds and lightning	1100	Seven, about 13 miles apart	.....	60
Inskip	Chico	69	Foothills and valleys	High winds and lightning	1200	One 41 miles from Inskip	.....	60
Coleman	Chico *via* Inskip	76	Lowlands and valleys	High winds and lightning	1200	One 41 miles from Inskip	Extra outlets carried to air switches outside station	60

TOWERS AND POLES

Station	Service	Height in Ft.		Spacing in Ft.		Ground Clearance in Ft. with		Type	No. of Circuits per Tower	Arrangement of Conductors	Spacing in Ft.	Position of Ground Wires
		Normal	Maximum	Normal, c	Maximum, d	c	d					
South	Standard	40	45	250	1200	30	35	A frame	1	Triangular	6	None
Volta	Standard	40	50	250	350	30	40	A frame	1	72-in. triangle on 60-kv lines, 42-in. triangle on 22-kv lines	....	None
	One circuit to Palo Cedro	35	....	140	.....	....	....	.....	1	.....	....	None
Kilare	South Line to Volta	30	....	180	.....	60	....	Cedar poles	.....	Triangular	3.5	None
	Northwest line to Kennett	30	35	135	.....	60	....	Cedar poles	.....	Triangular	4.5	None
So. Cow Creek	Standard	40	60	250	1900	25	....	A frame on wide spans	1	Triangular	6	None
Inskip	Standard	40	60	250	1800	30	50	A frame	1	Triangular	6	None
Coleman	Special Standard	40 40	....	250 250	1800 790 ft. on wooden A frame with suspension type insulators	30	....	A frame Cedar poles	1	Triangular Triangular	6 6	None .....

Station	CONDUCTORS			INSULATORS		
	Route	Material and Cross Section	No. of Strands	Service	No. of Sections	Type
South	To: Volta, Inskip	No. 1 copper	Solid	Standard Angles	4	Locke 351 pin Locke 351 pin
Volta	To: Palo Cedro	No. 4 copper	Solid	Standard	4	Locke 351 pin
	To: Palo Cedro	Three No. 4 twisted No. 00 copper	19			
	To: Chico	Nos. 0 and 00 aluminum	7	Special	1	Hemingray Provo pin
	To: Inskip *via* South	No. 1 copper	Solid			
		No. 1 copper	Solid			
Kilare	To: Volta, Kennett	41,700 circ. mil copper 66,370 circ. mil copper	Solid Solid	Standard	1	Hemingray Provo pin
Inskip	Chico	No. 0 aluminum No. 00 aluminum No. 1 copper	7 Solid	Standard Special	4 4	Locke 351 pin Locke 364 pin suspension type used on long spans
South Cow Creek	Chico	No. 4 copper No. 0 aluminum cable No. 1 aluminum cable	Solid 7	Standard Special on wide spans	4	Locke 351 pin Locke suspension
Coleman	Inskip	No. 00 aluminum cable No. 0 copper No. 1 copper	7 Solid Solid	Standard	4	Locke 351 pin

GENERATING STATIONS CONNECTED ELECTRICALLY			TRANSMISSION	MISCELLANEOUS		
Location or Name	Rating (Kva)	Type	Circuit Mileage at Each Voltage	Number Substations	Gross Annual Earnings	Companies with Which Connected Electrically
South	4,000	Hydroelectric	66,000 volts	46	$692,733 for sale of electrical energy year ended Dec. 31, 1914	Sells energy to Pacific Gas & Elec. Co. and Oro Electric Corporation
Volta	6,650	Hydroelectric	366 miles			
Kilare	3,000	Hydroelectric	20,000 volts			
South Cow Creek	1,500	Hydroelectric	64 miles			
Inskip	6,000	Hydroelectric				
Coleman	15,000	Hydroelectric				

with the similar costs of other companies based on statistics in Walker's Manual:

	Per Cent of Operating Expenses, Maintenance and Taxes to Gross Income	Per Cent of Interest Charges to Gross Income
Sierra & San Francisco Power Company	47.0	69.0
California-Oregon Power Company	41.0	56.6
Coast Counties Gas & Electric Company	58.3	21.5
Great Western Power Company	35.8	46.0
Mount Whitney Power & Electric Company	41.5	20.4
Pacific Gas & Electric Company	51.1	24.1
Pacific Light & Power Corporation	55.2	18.1
San Joaquin Light & Power Corporation	47.7	24.4
Western States Gas & Electric Company	56.2	25.1
Northern California Power Company	35.7	43.1

Western States Gas & Electric Company

The Western States Gas & Electric Company furnishes gas and electric service in the city of Stockton, and electric service in Richmond and Placerville, Cal. The property is owned by H. M. Byllesby & Company, of Chicago, but as properties go on the Pacific Coast it is not very large. Electric service is furnished to Stockton and the towns of Gault, Lodi, Floran and Placerville, together with the contiguous territory, by means of duplicate 60,000-volt transmission lines from the company's hydroelectric station on the south fork of the American River near Placerville, supplemented by a steam station situated in Stockton. In the territory around Stockton gold-dredging operations are carried on, and the rich agricultural districts are irrigated by motor-driven pumps. The company also purchases electrical energy from the Pacific Gas & Electric Company, the Great Western Power Company and the Sierra & San Francisco Power Company. The hydroelectric station on the American River contains two 1500-kw units driven by two 3000-hp impulse wheels. The Stockton steam plant is housed in a corrugated-iron steel-frame building and contains a 1500-kw vertical turbo-generator and three oil-burning water-tube boilers.

Snow Mountain Water & Power Company

The Snow Mountain Water & Power Company operates a high-head electrical plant in Potter Valley, 17 miles from Ukiah. The station contains three 2300-volt, three-phase, sixty-cycle generators with an aggregate rating of 6000 kw. The voltage is stepped up to 50,000 volts for transmission. The company sells most of its energy in bulk to the Pacific Gas & Electric Company at Santa Rosa, 75 miles from its generating station, and to other utilities in that section of the State.

Oro Electric Corporation

The Oro Electric Corporation was incorporated March 13, 1911, under the laws of California. The company commenced operations Nov. 1, 1911. It owns undeveloped power properties on Deer Creek and Mill Creek, in Tehama County, and on Yellow Creek and adjacent streams in Plumas County, Cal., from which streams approximately 130,000 hp may be developed. It also owns two hydroelectric generating plants on the west branch of the Feather River and the transmission system and substations for the city of Oroville and vicinity. It started but suspended work on a 50,000-hp hydroelectric plant on Yellow Creek, Plumas County, last year, and erected a steam relay plant at Stockton. On Nov. 22, 1911, the company acquired the entire outstanding capital stock of the Oro Water, Light & Power Company, which owns the electric distributing system, the gas and water plants and distributing systems in Oroville and vicinity; also five gold dredges and extensive dredging land in Oroville, Camanche and other places in that vicinity.

Substation Serving Exposition Grounds

The Pacific Gas & Electric Company has the exclusive contract for supplying all electrical energy for the Panama-Pacific Exposition and has installed special equipment capable of furnishing 20,000 hp to the Exposition grounds. The company's principal Exposition substation, situated in the Sierra & San Francisco Power Company's steam plant, near Machinery Hall, is connected by duplicated 11,000-volt underground cables with Substations A and D of the Pacific Gas & Electric system. Groups of 1500-kw transformers step down to the 4150-volt substation bus, from which fifteen underground cables feed directly into the Exposition grounds. The station bus is arranged in two sections, tied together through an oil switch. Each section feeds one-half of the grounds, but the two systems can be tied together so that, in case of trouble, the entire installation may be fed from either bus section.

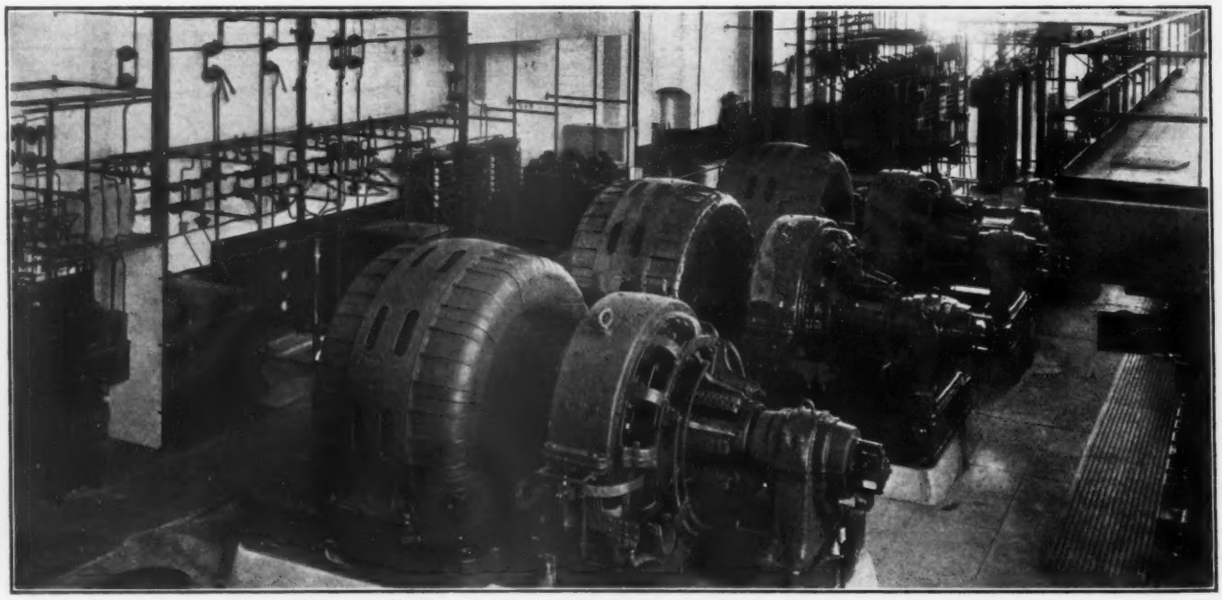


FIG. 39—SERVICE STATION FOR PANAMA-PACIFIC INTERNATIONAL EXPOSITION IN ONE END OF STEAM PLANT OF SIERRA & SAN FRANCISCO POWER COMPANY

Illumination at the Panama-Pacific Exposition

Elaborate Lighting Arrangements Which Enhance Architectural Features of the Palaces at San Francisco—Use of Concealed Arc and Incandescent Units

ASIDE from the magnitude and splendor of the lighting effects achieved at San Francisco, the essential difference between the illumination of the Panama-Pacific International Exposition and that of previous expositions lies in the fact that in the earlier displays outline illumination was invariably employed, an arrangement which, although bringing out the outlines of the buildings at night, generally suppressed their architectural and artistic features. The illumination of the San Francisco fair, however, depresses the light sources themselves, while bringing out and enhancing the architectural and artistic details of the Exposition palaces and towers.

The general methods employed to accomplish this result, the brilliant "scintillator" effects which span the night skies, the illumination of the spectacular and unique Tower of Jewels, on which are suspended more than 100,000 cut-glass gems, the lighting of the Horticultural dome, and numerous other details of the elaborate illumination of buildings and towers, were described in the ELECTRICAL WORLD for Feb. 13, 1915. There are, however, a number of instances where the departure from the outline scheme of illumination, accompanied by careful studies of the problems presented, has produced lighting effects worthy of more extended consideration.

In designing the illumination of the Court of Abundance, efforts were made to strengthen the impression of mystery which the architect wished to convey. This is accomplished by a harmonious blending of illumination from searchlamps, incandescent lamps, gas flambeaux and illuminated steam. Masked shell standards illuminate the cornice lines of buildings and produce a general twilight effect. Steam-electric caldrons are used to give rise to "mysterious vapors" and to add mystery to the simple fountain group symbolizing the earth in formation. A warm amber glow is diffused over the whole court and the organ tower by means of cloister lanterns, snow-crystal standards and colored searchlamps.

Two fountains in the Court of the Universe symbolize respectively the rising and the setting sun, and from their height of 95 ft. above the sunken gardens serve as light sources to illuminate the area of nearly half a million square feet. Each fountain consists of a translucent shaft and ball, in the interior of which are installed tungsten-filament lamps totaling 500,000 cp but so distributed that the intrinsic brilliancy is rela-

FIG. 1—FINE ARTS BUILDING AND LAGOON—ILLUMINATION BY SEARCHLAMPS AND CONCEALED INCANDESCENT SOURCES

FIG. 2—PANORAMA OF THE GROUNDS, SHOWING SCINTILLATOR PROJECTORS IN OPERATION

FIG. 3—A TWILIGHT VIEW OF THE TOWER OF JEWELS, SHOWING THE BANNER STANDARDS FOR THE FAÇADE LIGHTING

tively low and the fountains are free from glare. The shafts and balls are made of heavy opal diffusing glass so coated on the outside as to give an imitation of travertine stone by day.

Concealed red and pale-yellow colored lamps are used to illuminate the great arches in such a way as to preserve the sense of their curvature and the relief of their surface decorations. Ninety seraphic figures with jeweled heads, mounted on the balustrade of the court, are illuminated by 180 searchlamps, the beams of which are blended with the rays of light from the fountains of the sun.

The illumination of the Palace of Fine Arts was designed to create a classical and sublime effect and to produce beautiful reflections in the lagoon. Searchlamps on the roof of the Palace of Food Products and Vegetation and concealed lamps in the rear cornice soffits of the colonnade are employed to produce this effect, the building itself appearing to be illuminated in "triple moonlight."

The entire aspect of the Exposition grounds can be changed on short notice by coloring the light on the flags, towers and buildings. For this purpose nearly 400 arc searchlamps ranging from 13 in. to 36 in. in size and 450 concentrated tungsten-filament searchlamps can be employed, use being made of colored gelatine screens, weatherproofed by coating with spar varnish mixed with turpentine. Special effects in green, orange and red have been produced in this manner as occasion has arisen.

FIG. 4—THE COURT OF ABUNDANCE—ONE OF THE MOST EXQUISITE PIECES OF LIGHTING ON THE GROUNDS

In a number of cases special illumination is employed for the interiors of the buildings. For large auditoriums and other large interior areas, where concealed lighting is desired, but where the dome or ceiling construction does not permit of its being employed, use is made of batteries of searchlamps placed beneath the

FIG. 5—THE COURT OF THE UNIVERSE—SHOWING THE SUN-FOUNTAIN SHAFTS WHICH ARE LUMINOUS BY NIGHT

main floor and so arranged as to concentrate their beams on a diffusing plate in a central opening for redistribution to the ceiling. The illumination of high bays is accomplished by placing lamps, singly or in pairs, in specially designed reflectors at the maximum height in order to prevent waste of luminous energy on vertical surfaces. The main buildings of the Exposition are lighted in this way, only 0.1 watt per sq. ft. being required, although the lamps in some cases are placed more than 100 ft. above the floor.

In the case of art galleries, lamps provided with suitable angle reflectors and placed above and around the perimeter of a skylight made of suitable glass are employed to give a good general distribution of light on the adjacent hanging surfaces. By employing this arrangement it is possible to use shadow curtains on the underside of the skylight around the perimeter of the inner side of the rows of lamps, so as to prevent cross reflection and thus eliminate glare on oil paintings.

The Exposition lighting was handled by the mechanical and electrical department under Mr. G. L. Bayley as chief; the plans for the lighting were produced by Mr. W. D'A. Ryan, chief of the bureau of illumination, and the work was installed under immediate direction of Mr. L. F. Leury, assistant chief of the mechanical and electrical department.

FIG. 6—AN EXPOSITION VISTA—AT THE LEFT THE MACHINERY BUILDING; AT THE RIGHT THE PALACE OF VARIED INDUSTRIES

Electric Developments on the Pacific Coast

High Operating Heads, Huge Water-Power Units, and Long Transmissions, at Pressures Up to 150,000 Volts, Characterize Great Coast Systems

DURING the past decade and up to the beginning of the year 1913 electrical developments in the three states on the Pacific seaboard followed one another very rapidly, and at one time during that period the development was greater than in any other section of the country. In fact, up to the year 1910 the operating companies found great difficulty in meeting the demands for electricity from their circuits. Approximately one-fourth of the entire generating capacity of the United States is used by approximately one-seventeenth of the country's population in the West, and this same population contributes one-seventh of the aggregate income of the electric-lighting industry.

Notwithstanding that the combined population of the States of Washington, Oregon and California is less than the population of New York City, the use of electricity per capita is greater on the Pacific Coast than in any other section of the country. Electricity is also cheapest on the Pacific Coast. California is the second State in the Union in kilowatt rating of stations, in water-power and in kilowatt-hour output, and is the third State in the Union in aggregate income. The three States together generate more electricity than Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Nebraska, Missouri, Kansas, Arkansas, Oklahoma, Louisiana and Texas combined. Within the past decade there has been an increase in the horse-power of motors on the Pacific Coast of over 1000 per cent.

It has been estimated that approximately 43 per cent of the total potential water-power in the United States is available in the Pacific Coast States, which have 11,504,000 hp out of a total of 26,736,000 hp, the minimum potential water-power of the country. Only a small percentage of the available water-power is, however, under development; but the huge figures presented by government officials are very misleading because only a part of the potential water-power is capable of commercial development.

With the rapid fall in all of the streams rising in the Cascade and Sierra Nevada ranges, dropping from elevations of 10,000 ft. to approximately 300 ft., very high heads prevail. The average annual rainfall varies from over 100 in. in the northwestern section to considerably less in the southern section. In the great valleys lying between the mountain ranges in California there is no rain for almost nine months of the year, which accounts for the extensive use of electric motors for pumping purposes in that part of the country. The mountains abound with numerous glaciers and snow fields, so that the run-off is not so rapid as would be supposed, the glaciers and snow fields acting as regulators of the stream flow. The climate along the entire coast is mild, and except in the mountains snow is never encountered, more difficulty being experienced by electric transmission companies with the fogs that set in from the ocean than from any other single trouble.

The area of the Coast States is immense, California alone being larger than the New England States plus New York, New Jersey, Delaware and Ohio. The population is centered in five cities, and without exception all of the electrical needs of these cities are supplied by long-distance transmission from hydroelectric developments. In each case the operating company also

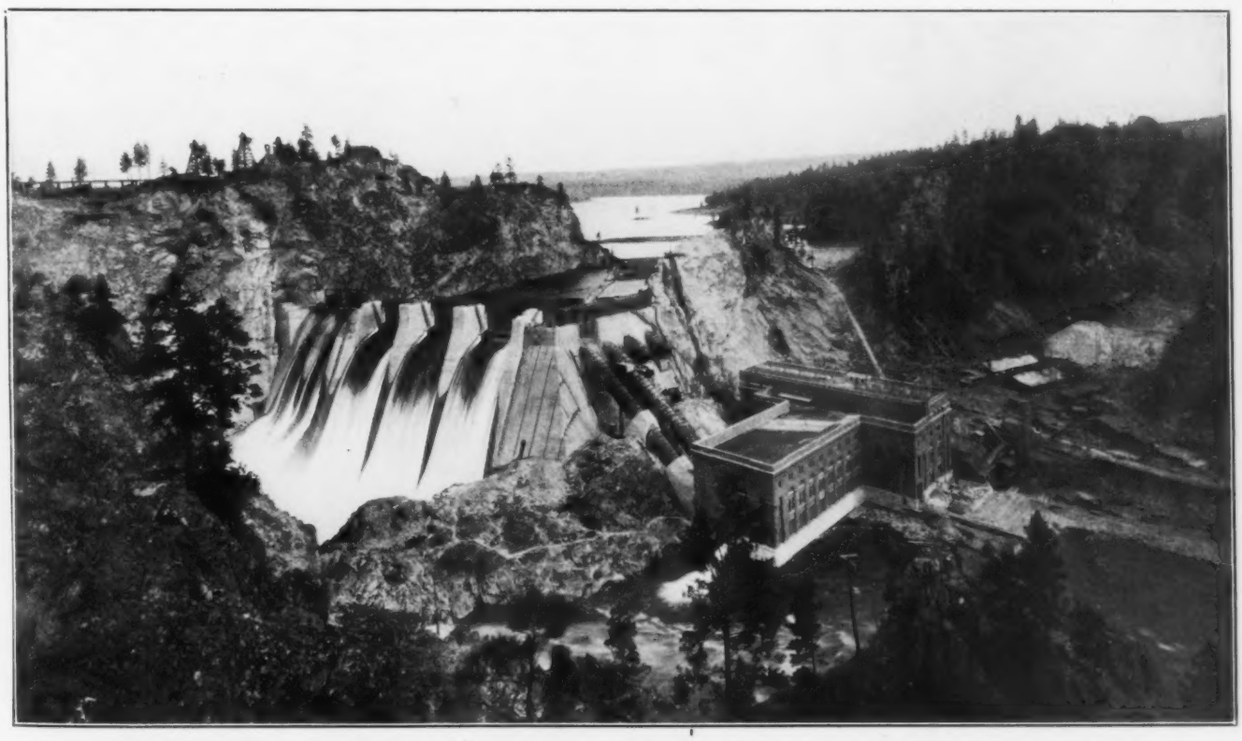


FIG. 1—THE LONG LAKE PLANT OF THE WASHINGTON WATER POWER COMPANY—THE HIGHEST-HEAD SPILLWAY DAM EVER BUILT

possesses large steam stations. In Washington and Oregon these stations are used chiefly for reserve purposes, while in California a large part of the yearly output of the companies is generated by steam.

Electrical Zones

Electrically considered the Pacific Coast section may be divided into several distinct zones centering around the large cities. In the eastern portion of the State of Washington is the city of Spokane, which dominates the Inland Empire. Electricity in that section is supplied chiefly by the Washington Water Power Company, which possesses, all things considered, one of the finest hydroelectric systems in the country. All of the four water-power developments of that company are situated on the Spokane River, as is also a large steam auxiliary station. Energy is transmitted by means of 600 miles of 60,000-volt lines into the various districts within a radius of 100 miles from Spokane, the most important load center being in the Cœur d'Alene mining district in Idaho, where electricity is extensively used in lead mines.

Farther west is the Puget Sound country, extending south from the Canadian border 175 miles and bordering on Puget Sound. The chief city is Seattle, and the electrical needs of the entire district are met for the most part by the Puget Sound Traction Light & Power Company. This company has approximately 75,000 hp in hydroelectric developments and 35,000 hp in steam stations.

Bordering on the Willamette River in the northern section of Oregon, and about 125 miles from the ocean, is the city of Portland, with its rich agricultural district. The Portland Railway, Light & Power Company supplies the territory extending from Portland to Salem, and its generating system is capable of developing over 85,000 hp, 54,000 hp being represented by hydroelectric stations and 32,000 hp by steam stations. Portland is also the headquarters for the Pacific Power & Light Company, which operates a number of hydroelectric properties in northeastern Oregon and southeastern Washington. This company, however, does not come into competition with the Portland Railway, Light

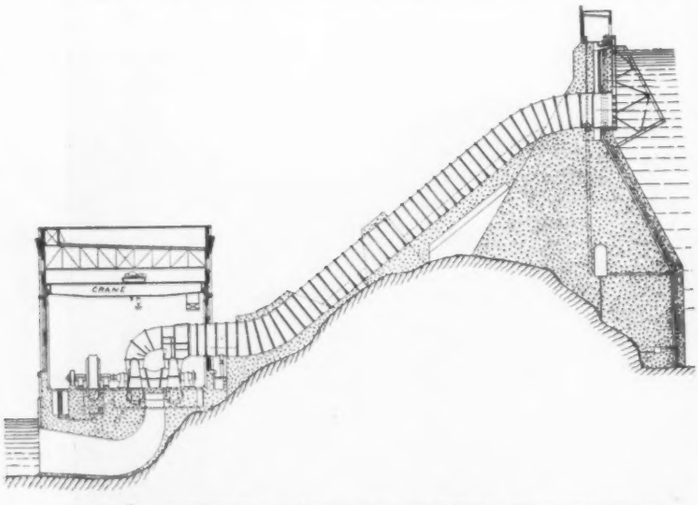


FIG. 2—SECTIONAL ELEVATION SHOWING THE PENSTOCKS 16 FT. IN DIAMETER

& Power Company. However, the Northwestern Electric Company, with a hydroelectric development of 13,000 kw on the White Salmon River and with a steam reserve station in the city of Portland, competes with the Portland Railway, Light & Power Company for local business.

San Francisco is the largest and most important city on the coast and is 771 miles south of Portland. It is the headquarters of the most important operating companies in the West. These are the Pacific Gas & Electric Company, the largest utility west of Chicago; the Great Western Power Company, the Sierra & San Francisco Power Company, and the Northern California Power Company, together with numerous smaller companies.

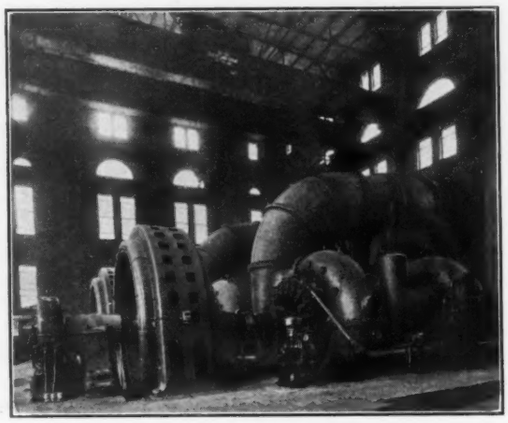


FIG. 3—THE 22,500-HP TURBINES IN THE LONG LAKE STATION

All of the hydroelectric systems feeding into San Francisco are situated long distances away from the city, and the steam stations are distinguished from the steam stations of the other two States in that oil is used for fuel and steam turbines are used exclusively. All of the great transmission systems leading into San Francisco are interconnected for the interchange of electricity, as described elsewhere in this issue.

Los Angeles, the next large city on the coast, traveling south, is located 482 miles from San Francisco and is the headquarters for the Southern California Edison Company and the Pacific Light & Power Corporation, both of which possess large generating systems.

A surprising range of plant frequencies still exists on the Pacific Coast. In Spokane and Seattle the standard frequency is sixty cycles. In Portland thirty-three cycles is still prevalent, although sixty-cycle equipment now predominates. All of the systems centering in San Francisco have sixty-cycle apparatus, while the systems centering in Los Angeles employ fifty cycles.

Farther inland, between the cities of Portland and San Francisco, is the Rogue River Valley, served with electricity by the California-Oregon Power Company, and the great Sacramento Valley, supplied in the upper section by the Northern California Power Company and in the center and lower sections by the Pacific Gas & Electric Company. South of the Sacramento Valley is the famous San Joaquin Valley, the electrical needs of which are supplied by the San Joaquin Light & Power Corporation of Fresno. Shut off entirely from this section is the territory in and around Los Angeles, while to the southeast of Los Angeles below sea level and extending to the Mexican line is the Imperial Valley, into which are carried the circuits of the Southern Sierras Power Company.

Washington Water Power Company

Of the four hydroelectric developments of this company the Post Falls development, the Little Falls development and the Long Lake development are of comparatively recent installation. A complete description of the Post Falls development (11,250 kw) appeared in the ELECTRICAL WORLD of May 23 and 30, 1908. The auxiliary 15,000-kw steam station in Spokane was described in detail in the ELECTRICAL WORLD of June 29, 1912, and

a description of the hydroelectric station at Little Falls (20,000 kw) was given in the June 22, 1912, issue.

The Long Lake development has just been partially completed and constitutes the latest and one of the most interesting stations on the Pacific Coast. It is situated about 24 miles northwest of the city of Spokane and 4.5 miles from the Little Falls station of the same company. At the site of the station the Spokane River makes a complete horseshoe bend and passes through a box canyon of granite formation rising to a height of about 350 ft. above the water surface. There the Washington Water Power Company has erected the highest spillway dam in existence, with the power station around the bend about 250 ft. from the dam, as is clearly shown in Fig. 1. The installation will consist of four 13,900-kva generators (two of which are at present installed) directly connected to four 22,500-hp turbines. The station when completed will be the largest of the company. The dam, which is thrown across the river, gives a fall of 170 ft. at the power house and backs up the water for 23 miles. Containing only 15 ft. of storage, the water thus held for reserve will be 2,695,000,000 cu. ft., all of which will be available not only at the Long Lake plant, but also at the Little Falls plant, 4 miles below the Long Lake development on the same river. The dam not only has the distinction of being the highest spillway dam now in existence, but at times of flood carries about 19 ft. of water over its crest.

Roller Dams on Spillway Crest

Three roller dams mounted upon the crest of the spillway will be used to hold the low-water level of the lake at the same level as at high water. Since it will not be necessary to employ the total head at this station for several years, the gates will not be installed until needed. They have been designed, however, in detail and constitute one of the features of the development. Each of the three rolling gates will give a clear opening 65 ft. in length and 19 ft. in height. Each will consist of a steel cylinder, 11.5 in. in diameter and 72 ft. long, having a shield on the upstream side 19 ft. in height. The gates will be separated by concrete piers 15 ft. wide, on top of which will be placed the houses for the operating mechanism. Each pier is recessed to receive the ends of the roller, hoisting cables and racks.

Each gate will be raised by means of a pair of 1.75-in. cables, which will pass around the end of the roller and be attached to the drum on the operating mechanism. The rack on which the toothed rim travels is placed on an incline, the total travel being 25 ft. and requiring in operation one hour. The total weight of the three gates with their operating mechanisms will be about 740,000 lb., and it is expected the leakage per gate will not exceed 1 cu. ft. of water per second. This tightness will be secured by means of water seals consisting of an oak timber placed on the lower end of the shield, which rests on an I-beam embedded in the concrete, and steel diaphragms on the ends to which is attached an oak timber that is forced against the flange of the I-beams placed on the side of the piers. This style of gate was chosen because of simplicity of construction, ease of operation and tightness of water seals, and also because it gave a large unobstructed opening.

The 22,500-hp Turbines—Efficiency 91 per Cent

The penstocks which lead down the incline from the side of the dam at right angles to the spillway are 236 ft. long and 16 ft. in diameter at the upper end and 14 ft. 10 in. at the lower end. The turbines, which are among the largest ever built, are of the double-inflow horizontal Francis type, manufactured by the I. P. Morris Company of Philadelphia. Each unit is made up of 83-in. twin runners inclosed in cast-iron volute casings and operating at 200 r.p.m. under an effective head of 168 ft. Although these units are guaranteed to show an efficiency of 85 per cent at three-fourths load, data obtained from the test runner indicate an efficiency of 91 per cent. The turbines were purchased subject to a bonus-and-penalty clause. The governors are of the I. P. Morris double-floating, lever-arm, oil-pressure type, and are guaranteed to maintain a speed that will not vary beyond one-half of 1 per cent.

The generators are wound for 4000 volts and have a normal rating of 13,900 kva when operating at 200 r.p.m.

FIG. 4—STRAIN TOWER ON 55,000-VOLT TRANSMISSION LINE

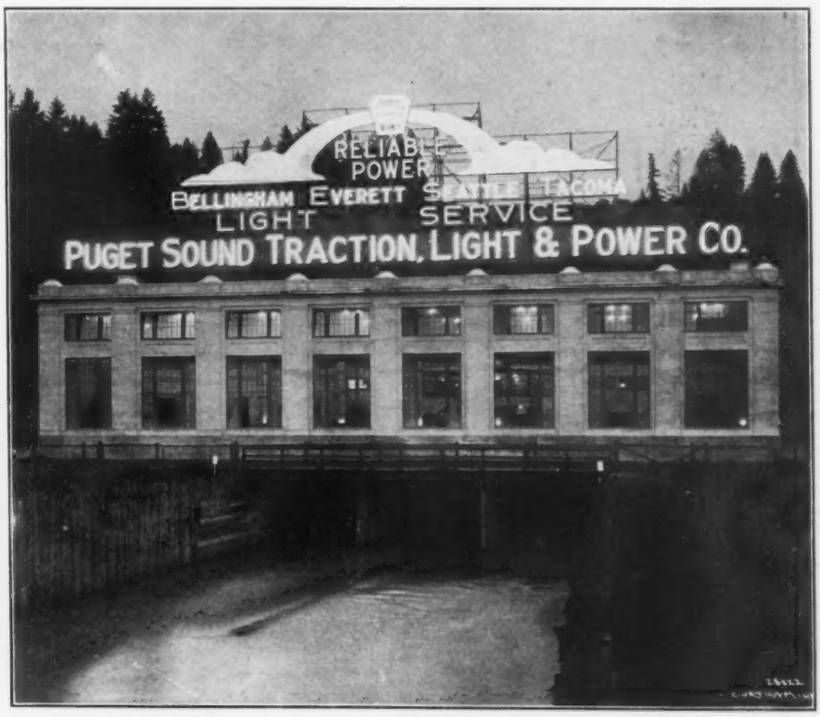


FIG. 5—WHITE RIVER PLANT (36,000 HP), SERVED BY WATER-STORAGE SYSTEM SUFFICIENT FOR THIRTY DAYS' OPERATION AT FULL LOAD

They have been tested at 100 per cent overload for five minutes and are capable of operating continuously under a 25 per cent overload at 90 per cent power-factor. When supplied with 60,000 cu. ft. of air per minute they can carry an additional load of 15 per cent, thus increasing the normal rating 40 per cent. Provision has been made for supplying the air through tunnels running directly into the generator pit. Temperature coils are laid in the armature slots in each phase and connected to indicators on the switchboard, which show the temperature of the armature windings at all times. Following the usual practice of the Washington Water Power Company, each generator shaft has at one end a 250-volt, 220-kw exciter, which will furnish sufficient energy to excite two generators.

Provisions for Transmission at 110,000 Volts

Each generator is connected to a bank of three 6500-kva, single-phase transformers. At present these transformers are delta-connected and operate at 63,600 volts. It is the intention, however, to connect them delta-star later and operate them at 110,000 volts. Water for cooling the transformers is supplied by a separate pipe running from the dam, the water passing through a Venturi meter equipped with a manometer with electric low-water alarm.

It should be pointed out that the Washington Water Power Company maintains its own erecting force, and its hydroelectric developments were carried on at such a time that as soon as the Post Falls development was completed this operating force began work on the Little Falls development, and when this was finished the operating force began the Long Lake development.

All of the stations were also designed by the company's engineering staff. It is for this reason that many features of construction peculiar to the company are to be found. Such changes as have been made have been suggested by the experience of the company in building its other stations, and also by its experience in operating the equipment. In its two recent stations the company has made a special effort to place the control of all electrical apparatus within easy reach of the switchboard operator. The attendant from his position at the switchboard is able to read every switchboard instrument and to control absolutely any electrical circuit in the station without taking more than half a dozen steps.

Although the station is designed with clearances for 110,000 volts, the disconnecting switches and high-tension buses are the only parts of the equipment so insulated at present. The low-tension oil switches are motor-operated and the high-tension switches are solenoid-operated. Voltage regulation is accomplished by means of Tirrill regulators in connection with high-voltage high-current cut-out relays. Between sections of the 4000-volt buses 10 per cent current-limiting reactances are connected, and these, with the inherent reactance in the generator, will limit the current flow between sections in case of short-circuit to a safe amount. No additional reactance is used between the generators and transformers, as their total reactance was considered ample to protect against short circuits on the high-tension side. The generator field rheostats, the exciter field rheostats and the turbine governors are all motor-operated, so that their control may be placed in the hands of the switchboard operator. The electrical equipment is of General Electric design.

The output of the Washington Water Power Company last year was 169,691,800 kw-hr. and the yearly load-factor of the system was 65.4 per cent.

Puget Sound Traction, Light & Power Company

The Puget Sound Traction, Light & Power Company is under the management of the Stone & Webster Management Association. The company operates a hydroelectric plant of 36,000 hp on the White River, 26 miles from Seattle, hydroelectric plants of 25,000 hp at Snoqualmie Falls, a hydroelectric plant rated at 30,000 hp at Electron, and steam stations in and about Seattle with an aggregate rating of 25,000 hp. It also operates a hydroelectric plant of 2000 hp in the mountains 35 miles from Bellingham and a 4000-hp steam station in the city of Bellingham.

The White River development, which will have an ultimate rating of approximately 108,000 hp, is the latest

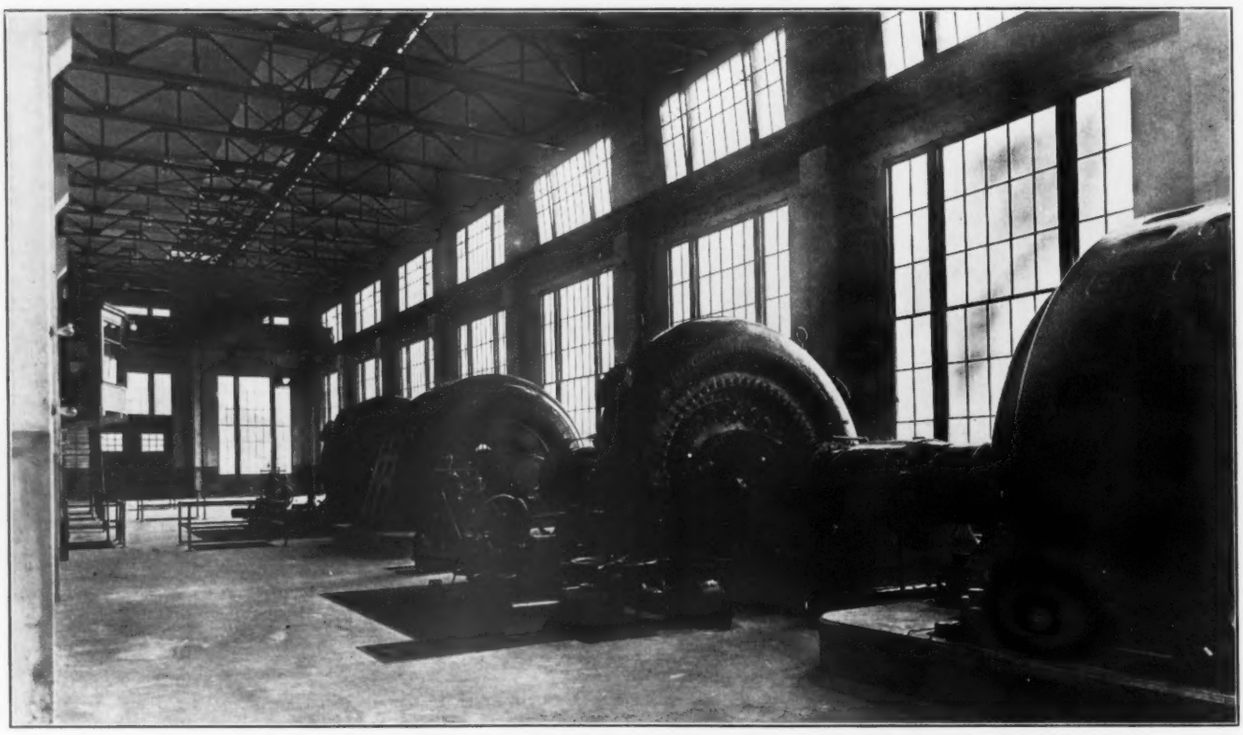


FIG. 6—THE 18,000-HP TURBINES IN THE WHITE RIVER PLANT OF THE PUGET SOUND COMPANY

and largest of the company's properties. A notable feature of the development is an immense storage system impounding water sufficient to enable the present installation of 36,000 hp to be operated at full load for an entire month. The company owns and operates substantially all of the street railway and the largest part of the electric business in Seattle, besides owning and

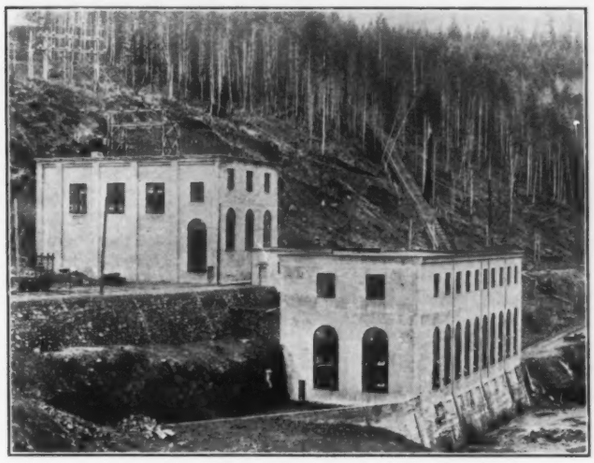


FIG. 7—THE BULL RUN PLANT OF THE PORTLAND RAILWAY & LIGHT COMPANY

operating the electric business in the larger cities and towns near Seattle and Tacoma. The principal offices of the company are at Seattle, Mr. Frederick S. Pratt, of Boston, being chairman of the board, and Mr. Alton W. Leonard being president of the company. The division manager at Seattle is Mr. A. L. Kempster, the division manager at Bellingham is Mr. L. R. Coffin, and the division manager at Tacoma is Mr. L. H. Bean. The Bellingham division purchases electrical energy from the Western Canada Power Company, whose generating system is located at Stave Falls in British Columbia, the Bellingham company taking as high as 5000 kw at the international boundary.

A rather complete description of all of the properties of this company located in Seattle was published in the June 1, 1912, issue of the ELECTRICAL WORLD, and no important additions have been made to the generating system since that time. The Bellingham system, comprising a generating station at Nooksack Falls and a steam auxiliary in the city of Bellingham, was described in the ELECTRICAL WORLD of July 20, 1912. In the city of Seattle the company competes for lighting load with the Seattle municipal plant (ELECTRICAL WORLD, June 1, 1912, Jan. 9, 1915), and in the city of Tacoma there is also a municipal plant (ELECTRICAL WORLD, Aug. 2, 1913). With these exceptions the company has no competition.

In point of output the Puget Sound Traction, Light & Power Company is among the largest of the country and is the third largest on the Pacific Coast. Last year its output was approximately 300,000,000 kw-hr.

Portland Railway, Light & Power Company

The Portland Railway, Light & Power Company has a generating system rated at approximately 100,000 hp. It operates five hydroelectric plants—Oregon City, 9640 hp; Cazadero, 19,000 hp; Silverton, 333 hp; Estacada, 18,000 hp; Bull Run, 19,000 hp. There are steam stations in Portland, Salem and Boring with an aggregate rating of 33,000 hp, the Portland steam stations being rated at over 30,000 hp. The development at Estacada on the Clackamas River will ultimately house five 6000-hp units, and the development at Bull Run on the Sandy River will eventually deliver 60,000 hp to Portland. The Estacada and Bull Run developments were completed recently. A detailed description of the Estacada plant was printed in the ELECTRICAL WORLD, July 13, 1912, and the hydroelectric development at Bull Run was described in the ELECTRICAL WORLD, March 22 and March 29, 1913. With the completion of these two developments the company has sufficient output to care for the demands for some years to come. The only new construction work undertaken since the completion of these stations has been a new transmission line from the Estacada hydroelectric development on the Clackamas River to a substation at Beaver Creek, a distance of 10 miles, which enables the company to supply energy for the operation of the Willamette Valley Southern Railway Company and to furnish electric service to Molalla.

Up to two years ago the company had no competition, but a little over a year ago the Northwestern Electric Company, with a development of 21,000 hp on the White Salmon River, entered Portland, and it is competing for business in that territory. A description of the White Salmon River development was printed in the ELECTRICAL WORLD, Aug. 9, 1913, and the steam reserve station of the company in Portland was described in the ELECTRICAL WORLD, Sept. 26, 1914. Notwithstanding competition, however, the Portland Railway, Light & Power Company is among the largest generating companies in the country and is the sixth in size on the Pacific Coast. Its output last year was approximately 185,000,000 kw-hr. Its generating stations now have ample equipment to meet the needs of the company for some years to come.

Pacific Power & Light Company

The Pacific Power & Light Company of Portland, Ore., operates generating and transmission systems in Oregon and Washington, its activities extending over the south, central and southeastern parts of Washington and along the northern part of Oregon in the territory tributary to the Columbia River, extending from the Pacific Coast to the western boundary of Idaho. The company's properties are situated in sixteen different counties in the States mentioned, and the total population served is about 115,000, an appreciable percentage of the total being found in rural and farming communities. The connected load is approximately 28,000 hp.

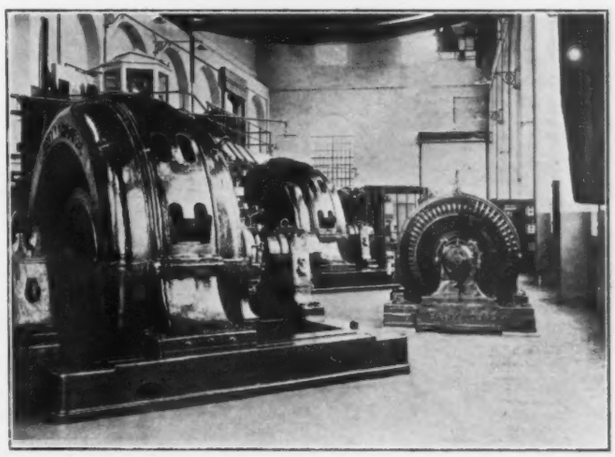


FIG. 8—INTERIOR OF BULL RUN STATION—TOTAL RATING 19,000 HP

The electrical properties of the company are divided roughly into four sections, three of which are connected by transmission lines. A standard transmission of 66,000 volts has been established, and practically all of the distribution in the irrigated districts and in the smaller towns is at 6600 volts. Practically all of the properties in the Yakima, Upper Columbia and Walla Walla divis-

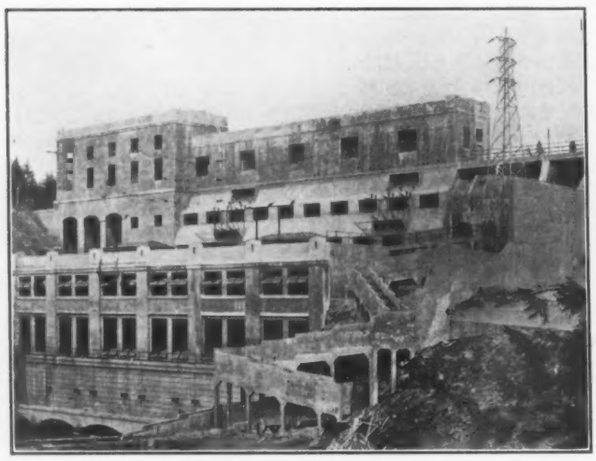


FIG. 9—DOWNSTREAM SIDE OF RIVER MILL PLANT, SHOWING FISH LADDER

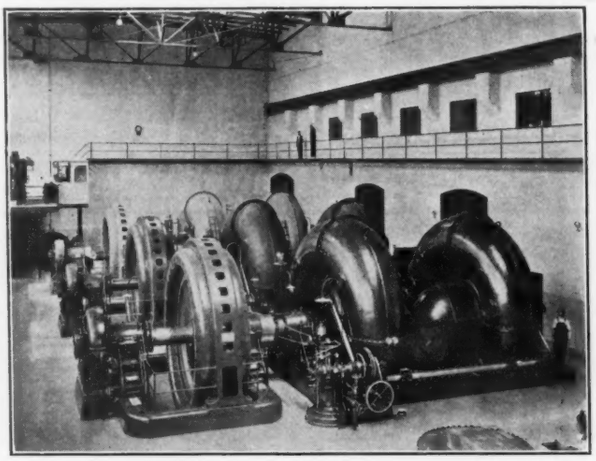


FIG. 10—DOUBLE-RUNNER TURBINE GENERATORS IN RIVER MILL PLANT—TOTAL RATING 18,000 HP

ions are tied together on one transmission and distribution system, extending from the power house on the Naches River, 10 miles northwest to North Yakima on the west, to Dayton, Wash., on the east, to Beverly, Wash., on the north, and to Pendleton, Ore., on the south. A complete description of the properties of the Pacific Power & Light Company was published in the ELECTRICAL WORLD, Sept. 14, 1912.

Recently an interesting addition has been made to the system in the shape of an automatic water-power station. In the year 1910 the Pacific Power & Light Company bought several hydroelectric and steam properties in Oregon and Washington. Included in these properties was a canal approximately 8 miles long, taking water from the Naches River, 20 miles from North Yakima, and returning it at the Naches power house, 12 miles from North Yakima. The canal, which was known as the Wapatox Canal, at that time carried approximately 300 cu. ft. of water per second.

Early in 1913 the company enlarged the canal and lined it with concrete for the purpose of adding another generator at the Naches power plant. The canal had two unused water-power sites in its profile, and under the reconstruction it was contemplated that part of the canal would be relocated and all of the head brought to one point. This was done in 1914, with the result that the company then had about 3 miles from its Naches power house a water-power site with a drop of a little over 50 ft., over which passes about 550 cu. ft. of water per second. This head has just been utilized for power purposes by the construction of a small building containing a single hydroelectric unit. The station is situated about one mile east of Naches River, Washington, and was built by the engineering department of the Pacific Power & Light Company.

The arrangement is such that the water may pass from the higher to the lower level, either through the power house or through a wasteway. Inasmuch as the water is used at the Naches power house at the lower end of the canal and is also used for domestic purposes in North Yakima, its flow cannot be interrupted. The generator installed is of the vertical induction type, rated at 1400 kw and generating three-phase, sixty-cycle, 2300-volt energy. The building is barely large

FIG. 11—TAILRACE AND DAM—RIVER MILL PLANT, PORTLAND RAILWAY & LIGHT COMPANY, AT ESTACADA

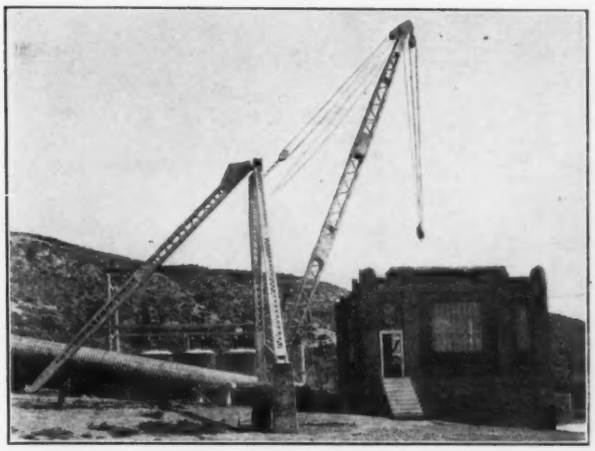


FIG. 12—NACHES 1400-KW AUTOMATIC STATION, SHOWING DERRICK

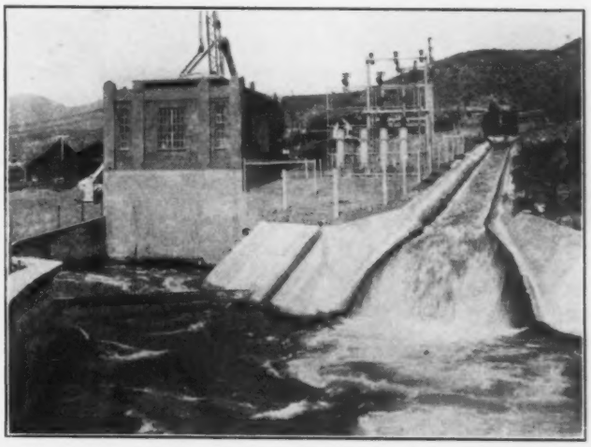


FIG. 13—SPILLWAY AND STILLING POOL OF NACHES DROP AUTOMATIC STATION

enough to contain the generator and is arranged with a movable roof or hatchway. In the yard adjoining is a steel stiff-legged derrick, which was used in placing the machinery and in building the power house. If at any time it is desired to lift out any of the machinery for repair purposes, the hatchway can be taken off and the apparatus lifted out by the derrick. Within reach of the derrick are also the lightning arresters and the 66,000-volt transformers which connect the station with the company's high-tension system. The lightning arresters and transformers are of the outdoor type. The generator, which floats on the company's system at all times, is equipped with a new type of Kingsbury bearing, and the oil supply is contained in a tank sufficient to lubricate the unit for twenty-two hours. When the supply in the tank gets low an electric connection causes a gong to ring and draws the attention of the sole operator, who lives in a nearby cottage. The top of the generator and the bearings are incased in a metal ventilated tube or shaft, which fits under the framework of the hatchway. A fan is used to suck the cold air from the outside through the hatchway, down through the machine and out of the aperture into the generator room below. The small switchboard necessary for controlling the output of the station is installed on a little gallery built on two sides of the power house.

Pacific Gas & Electric Company

For a number of years prior to the close of 1913 the Pacific Gas & Electric Company was handicapped by its inability to supply from its own stations the ever-increasing demands of its markets for hydroelectric energy and was compelled to meet the deficiency by purchases of energy from other companies and by the more costly method of steam generation. In order to render itself independent of outside sources, as well as to provide for future growth and to enable it to obtain energy at the minimum cost, the company undertook the development of its water-powers on the South Yuba and Bear Rivers, where an ultimate output of 190,000 hp is possible. The work was begun in the summer of 1912, and by Jan. 1, 1914, approximately $7,000,000 was expended on the hydraulic work, generating station and steel-transmission line to the company's substation at Cordelia, and from Cordelia around the north arm of San Francisco Bay to a point approximately opposite the city of San Francisco, with the ultimate object of crossing the south arm of the bay and increasing the present supply of hydroelectric energy by this addition to the present transmission facilities into San Francisco. The Drum power house (see ELECTRICAL WORLD Nov. 22, 1913), the first of six, was completed Nov. 25, 1913, with an initial installation of 25,000 kw, and since the

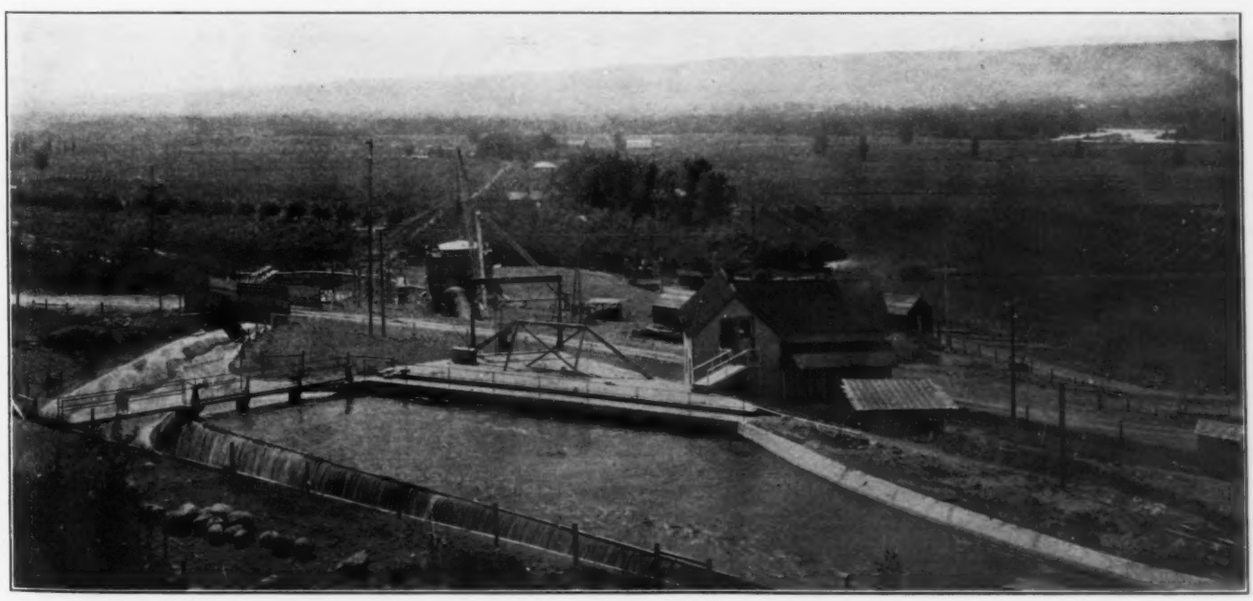


FIG. 14—PANORAMA OF THE NACHES DROP 1400-KW AUTOMATIC STATION OF THE PACIFIC POWER & LIGHT COMPANY

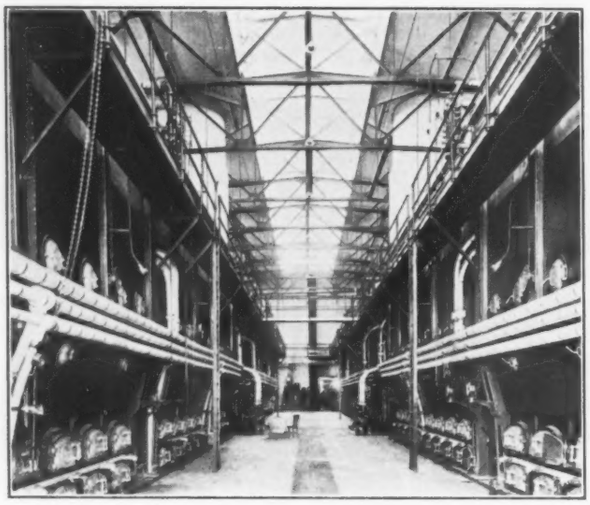


FIG. 15—BOILER ROOM IN LONG BEACH STATION

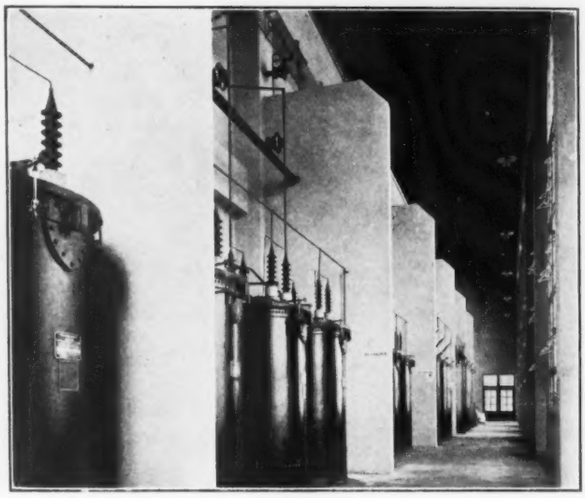


FIG. 16—TRANSFORMERS AND HIGH-TENSION BUSES

first of last year this station has been steadily delivering energy throughout the system. Definite plans contemplate additions to this development by doubling the present generating equipment of the Drum station and by the construction of five additional power stations, all of which will use the water storage of the main reservoir at Lake Spaulding, ditches, tunnels and pipe lines already being provided for its conveyance. The average investment per horse-power as the work progresses will therefore rapidly decrease. An incidental feature of the project will be the utilization of the water after it has gone through all of the power houses for irrigating about 45,000 acres of land.

Various other interesting features appertaining to the system of the Pacific Gas & Electric Company and of the other companies in San Francisco are described elsewhere in this issue. The output of the Pacific Gas & Electric Company's system last year was 658,298,000 kw-hr., and the yearly load-factor of the system was 60.6 per cent.

Southern California Edison Company

The Southern California Edison Company operates extensively in the vicinity of Los Angeles from the ocean to Redlands. Electricity is generated in seven hydroelectric stations and three steam stations with ratings as follows:

Power House	Ratings in Kw
Hydroelectric stations:	
Kern River No. 1	20,000
Santa Ana River No. 1	3,000
Santa Ana River No. 2	1,000
Mill Creek No. 1	750
Mill Creek Nos. 2 and 3	3,250
Lytle Creek	500
Steam stations:	
Redlands	600
Los Angeles No. 3	10,000
Long Beach	47,000
Total	86,100

The company has also been granted permission by the government to develop additional electrical energy in

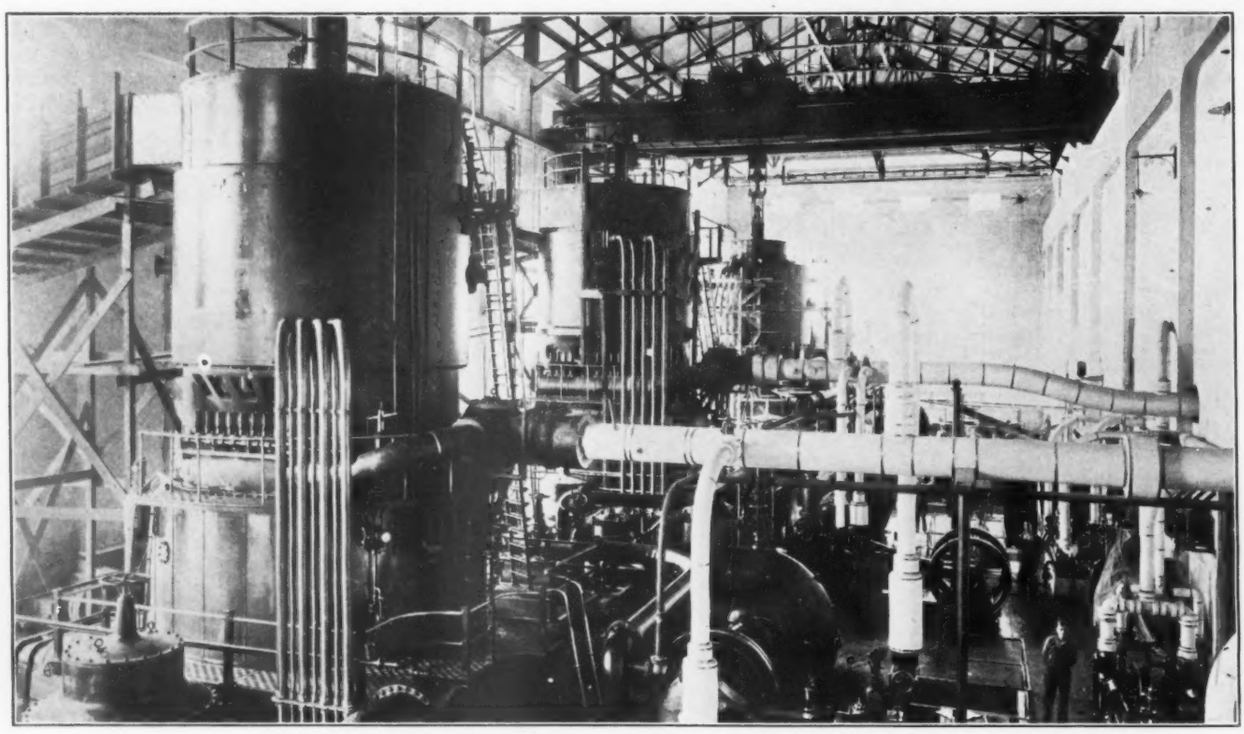


FIG. 17—LONG BEACH STEAM STATION OF THE SOUTHERN CALIFORNIA EDISON COMPANY AT LOS ANGELES

the Kern National Forest. Of the seven hydroelectric stations now in operation one is in the Kern and five others in the Angeles national forests. Six are capable of developing 37,800 hp, although there is not sufficient water to develop this amount of power continuously.

The Secretary of Agriculture has granted the company permits for four new projects, which have been designated by the company as Kern River plants Nos. 2, 3, 4 and 5. According to the estimates of the government's engineers, the four new projects will be able to supply about 33,000 hp except for a few days in a period of five years. Through the use of a steam auxiliary plant, however, the company will be able to supply considerably more than that amount, and it is planned to install machinery having a total rating of about 80,000 hp. This will be transmitted over a distance of about 155 miles to Los Angeles. It is expected that plant No. 3 will be the first to be put into operation, with plants Nos. 4, 5 and 2 following in the order given as the demand of the market increases. By its agreement with the Department of Agriculture the company has ten years left in which to place the plants in complete operation.

The present hydroelectric plants, with the exception of that on the Kern River, are relatively close to Redlands, and, with the Redlands steam plant, may be considered as one unit of the generating system, with the principal receiving substation in the city of Colton. The Colton group is widely separated from the other generating stations, although there is a steel-tower line connecting the Colton substation with the steam stations at Los Angeles and Long Beach and with the Kern River hydroelectric station. A complete description of the 60,000-volt steel-tower line of the company was printed in the ELECTRICAL WORLD, Aug. 9, 1913, and a description of the Long Beach steam station was published in the issue for March 9, 1912. The hydroelectric development in Kern River was described in the ELECTRICAL WORLD Aug. 10, 17, 24 and 31, 1907. Last year the Southern California Edison system generated 288,549,552 kw-hr. and the yearly load-factor was 61.1 per cent.

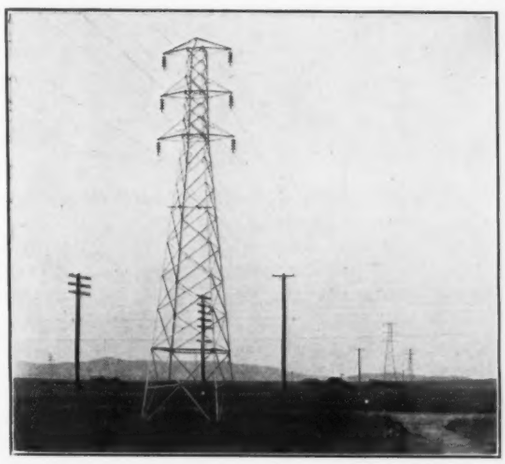


FIG. 18—LONG BEACH-COLTON TRANSMISSION LINE—60,000 VOLTS

FIG. 19—KERN RIVER PLANT NO. 1 OF SOUTHERN CALIFORNIA EDISON COMPANY

Pacific Light & Power Corporation

The Pacific Light & Power Corporation was organized under the laws of the State of California, and took over all the properties of the Pacific Light & Power Company of Los Angeles in 1910. At that time the Pacific Light & Power Company was operating six hydroelectric generating stations, with a total rating of 19,233 hp, and three steam generating stations, with a total rating of 55,900 hp. One hydroelectric station was situated on the Kern River, one east of the city of San Bernardino in San Bernardino County, two in Riverside County, and the rest of the hydroelectric and all of the steam generating stations were situated within the limits of Los Angeles County.

The Kern River station was connected to a substation in the city of Los Angeles by two parallel 50,000-volt lines, each 117 miles long. The other generating stations were interconnected by a network of 15,000-volt lines, which furnished energy to substations in various cities and towns in Los Angeles, San Bernardino and Riverside Counties, as well as to irrigation consumers along the line. Soon after the reorganization of the company under the corporate name of the Pacific Light & Power Corporation the development of the Big Creek hydroelectric project began. This project will consist ultimately of four power houses on the San Joaquin River and Big Creek in Fresno County, and the energy will be transmitted over three parallel steel-tower lines at a tension of 150,000 volts to the city of Los Angeles, 241 miles distant. The power houses will be so situated that the water will be used successively through each one. Two reservoirs will eventually be constructed, one having an ultimate capacity of 103,160 acre-ft. and the other of 25,490 acre-ft. With the completion of this system the company will be enabled to generate, through the operation of the Big Creek project, 405,000 hp.

In November, 1911, work began on the Big Creek development. This comprised, besides the necessary road to reach the site, the construction of three concrete gravity-section dams, bringing the capacity of the largest proposed reservoir up to 50,000 acre-ft.; the construction of tunnels through solid rock to their ultimate capacity leading to power houses No. 1 and No. 2; the construction of power houses No. 1 and No. 2 to one-half their ultimate size, and installation of the necessary generating equipment; the construction of two of the three steel-tower transmission lines to Los Angeles, and the erection of a large concrete substation outside of the city limits of the city of Los Angeles. This work was completed and the power houses were placed in operation in December, 1913. By this means 80,000 hp was added to the system of the company, enabling the corporation under average conditions to dispense with the operation of its steam stations except in cases of emergency. A complete description of the Big Creek development was published in the ELECTRICAL WORLD Jan. 3, 1914, and Jan. 10, 1914.

At present the corporation furnishes all the energy

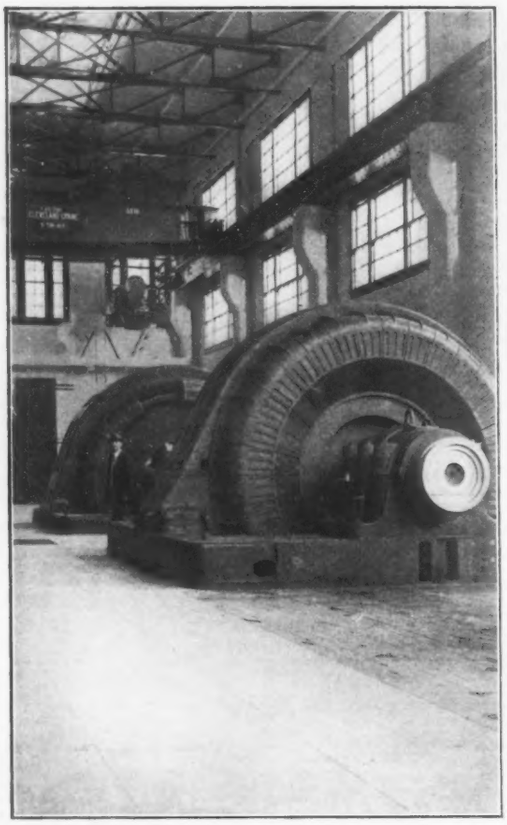


FIG. 20—SYNCHRONOUS CONDENSERS IN SUBSTATION AT END OF 150,000-VOLT LINE

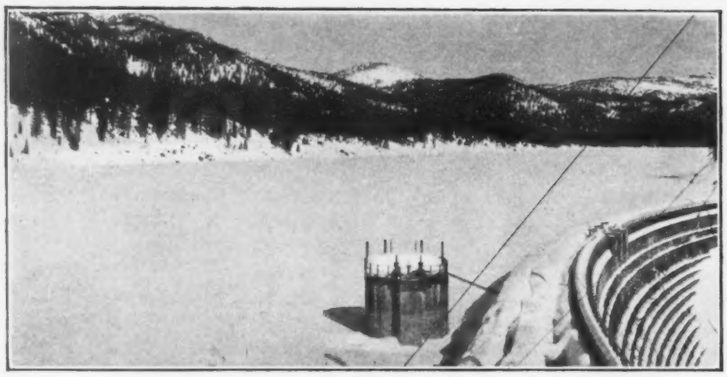


FIG. 21—DAM AND INTAKE, BIG CREEK PLANT

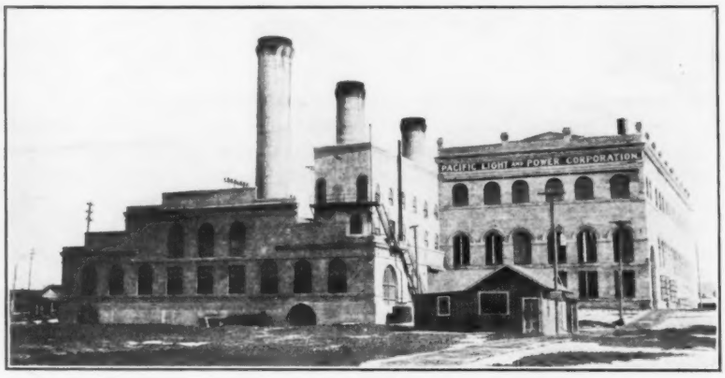
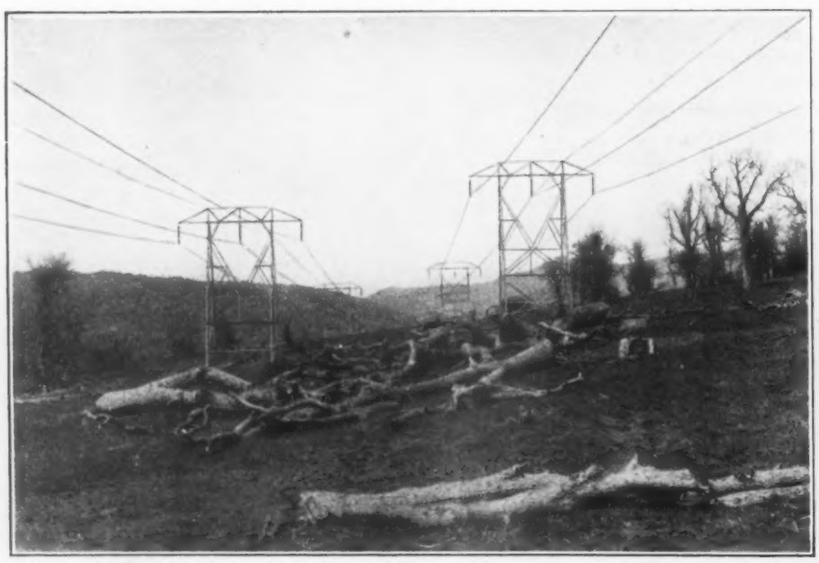


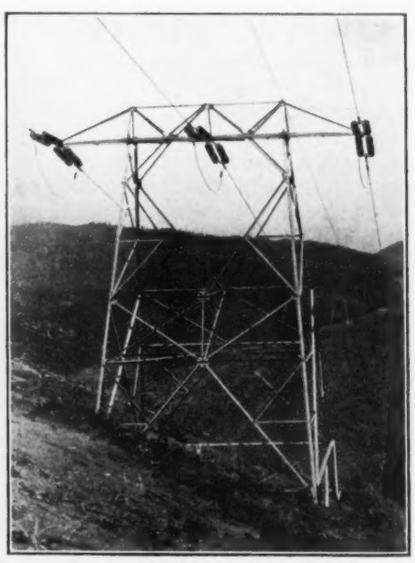
FIG. 22—REDONDO STEAM PLANT OF THE PACIFIC LIGHT & POWER CORPORATION

used by the Los Angeles Street Railway Company and most of the energy used by the Pacific Electric Railway Company. These roads have trackages of 360 miles and 560 miles respectively. The company also distributes energy for commercial and residential uses in Los Angeles, San Bernardino, Riverside, Orange and Ventura Counties, as well as in many of the cities and towns therein. Next to the railway load the most important motor load is irrigation.

Although a great deal has been written on the Big Creek development, it still remains the center of electrical interests on the Pacific Coast; 60,000 kw is generated in two stations under a combined head of 4000 ft. and transmitted 240 miles at 150,000 volts to Los Angeles. It is worthy of note that since its operation the continuity and reliability of the service and the voltage regulation have been better than when the source of supply was the large modern steam station located at Redondo and transmitting energy at 15,000 volts over a 20-mile line to Los Angeles.

Each of the main generating units in the Big Creek station is driven by two tangential waterwheels, and a separate governor is provided for each, so that one or both runners may be operated according to the demands





FIGS. 23 AND 24—THE WORLD'S HIGHEST-VOLTAGE TRANSMISSION LINE—THE BIG CREEK 150,000-VOLT SYSTEM OF THE PACIFIC LIGHT & POWER CORPORATION

of the load. The governors actuate needle nozzles which change the sizes of the water jets. In order to avoid sudden pressures in the penstocks should the governors shut off the water suddenly, a water-balanced bypass valve is provided which opens quickly and discharges into an energy absorber. The bypass then gradually closes, relieving the penstock from excessive pressures.

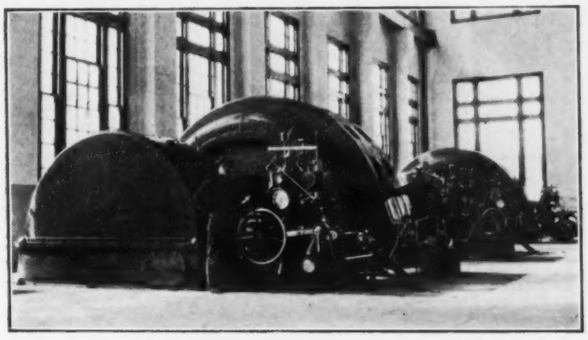


FIG. 25—POWER HOUSE NO. 1, BIG CREEK DEVELOPMENT

The regulation is such that with the Big Creek development operating in parallel with the 40,000-kw steam station in Redondo (see ELECTRICAL WORLD, June 15, 1912) the waterwheel governors absorb the changes of load faster than do the steam turbines. Although the contract for the electrical equipment was divided impartially between the General Electric and Westinghouse companies, operating experience has not brought out any noticeable general superiority of the work of one over the other.

The voltage regulation is perhaps the most interesting part of the system and has been effected by the use of two 15,000-kva synchronous condensers at the receiving station in such a way that any desired voltage is maintained, irrespective of the power-house voltage. As at present operated the generated voltage at the power house is held constant at 150,000 volts from 6:30 a.m. until 9 p.m., after which it is dropped automatically to 135,000 volts. Any change of voltage necessary at the substation is taken care of locally by adjustment of the voltage regulator.

In the operation of the system many points of interest have been brought out. At first the synchronous condensers were started with a crane, the starting switch

FIG. 26—150,000-VOLT LINE LEAVING BIG CREEK STATION NO. 1

being thrown in at the same time at a potential 50 per cent of normal and requiring 10,000 kva. Oil under high pressure is now used in the bearings under the shaft, and in starting the switch is closed with no field and the machine comes up to speed and drops into step. The field circuit is then closed and adjusted to a predetermined point, after which the running switch is closed. Unless the field is properly adjusted, however, there is more or less disturbance caused when the machine is switched over.

The reactance of the main generators is very high, being 70 and 85 per cent respectively. When to this is added 5 to 8½ per cent for transformer impedance it is apparent that short-circuit currents are limited. Thus a short-circuit on the line has caused the generators to lose their load and the governors to shut off water. Such short-circuits as have been experienced on the system have occurred between one or more conductors and ground. In order to be able to reduce the voltage to suppress the arc and restore normal conditions rapidly, auxiliary field rheostats have been connected in series with the rheostats, which are acted upon by the voltage regulators. When a short-circuit occurs the auxiliary rheostats are used to lower the voltage until the arc breaks, this latter condition being indicated on the neutral ground ammeter. Most of the troubles thus far ex-

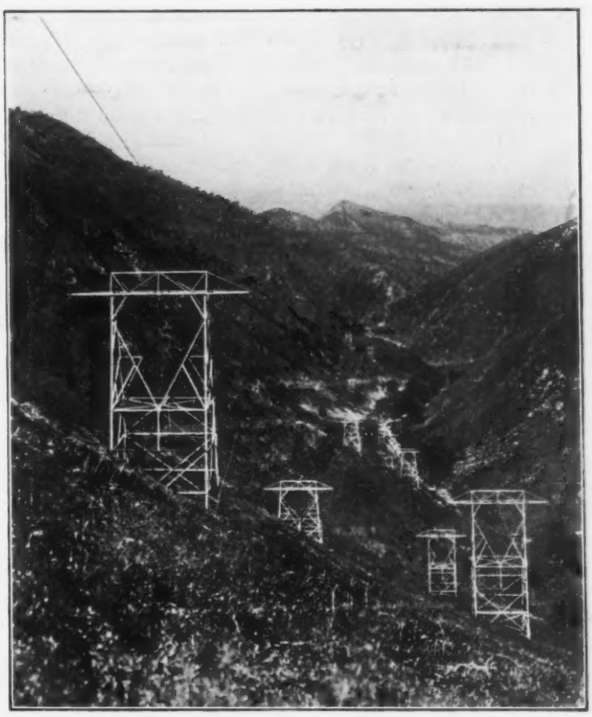


FIG. 27—CHARACTER OF COUNTRY TRAVERSED BY THE 150,000-VOLT LINE OF PACIFIC LIGHT & POWER CORPORATION

perienced are due to insulator flashovers, and the arcing rods have been found generally to protect the insulators and aluminum cables against damage.

Certain peculiarities have been noted on the line since its operation. Snow collects faster on a dead line than on a line energized, even though not under load. Owing to the fact that a dead section of the duplicate line 100 miles in length has a potential of 4200 volts induced in the nearest conductor, strict rules are enforced in regard to grounding whenever any work is to be done.

The Pacific Light & Power Corporation's system is the fourth in point of output on the Pacific Coast. It generated last year 292,545,094 kw-hr., and the load-factor of the system was 47.37 per cent.

Southern Sierras Power Company

The Southern Sierras Power Company operates in the southern section of California, although the system now reaches and serves, besides mines in southern Nevada, a variety of interests in California, including an agricultural load in Riverside, San Bernardino and Imperial

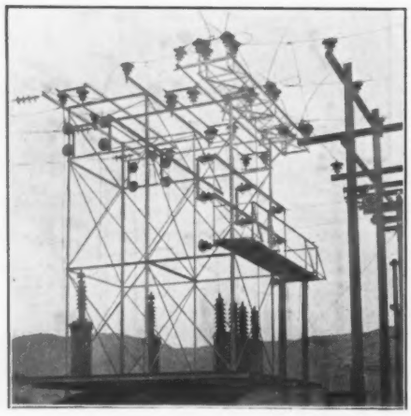


FIG. 28—A HIGH-VOLTAGE METER INSTALLATION

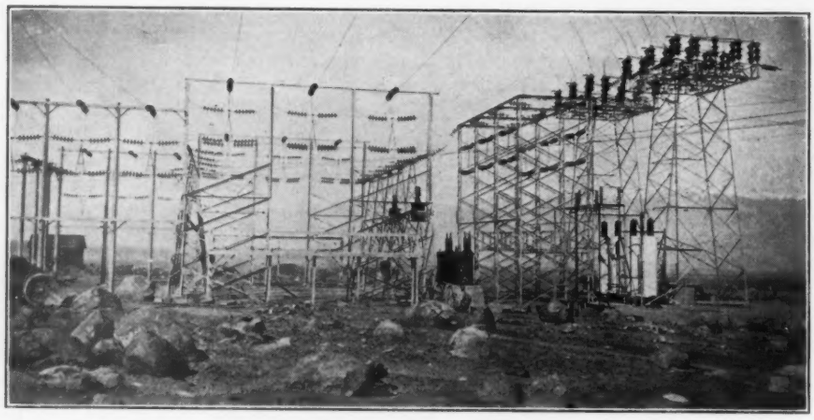


FIG. 29—CONTROL SWITCHING STATION AT NORTH END OF 240-MILE TOWER LINE OF SOUTHERN SIERRAS POWER COMPANY

Counties, where energy developed on Bishop Creek is used and some even transmitted across the Mexican border. The company possesses the longest transmission line in the world, and besides its lighting loads supplies energy to motors aggregating 35,000 hp as follows: Mines and mills, 18,800 hp; industrial load, 7400 hp, and irrigation load, 9200 hp. The extension into the Imperial Valley is the latest addition to the company's system.

The complete development of the Southern Sierras Power Company was described in great detail in the ELECTRICAL WORLD of Oct. 17, 24, 31, Nov. 7, 14, 21, 28, and Dec. 5, 12 and 19, 1914. The substation equipment for the most part is of the outdoor type, and although the transmission system is designed for 140,000-volt operation, the system at present operates at 55,000 volts.

Some Interesting Features

Fig. 28 shows a high-voltage meter installation in the Imperial Valley. The Coachella Valley Ice & Electric Company purchases energy at 55,000 volts from the Southern Sierras Power Company and transmits it over a 130-mile line into the Coachella Valley and the Imperial Valley. The energy is metered at the point of delivery to the company's line, which is at the Southern Sierras substation at Banning. The switch and meter transformer house consists of a structure of galvanized steel having a platform about 10 ft. above ground for the support of the transformers. From this platform the disconnecting and local switches are operated, and the shunt transformer fuses are handled from the smaller platform above. The series transformers are provided with both shunt and disconnecting switches so that they may be removed from the line without interruption to service. The base of the tower is used as a frame for a meter room, the walls and roof being of cement plaster on expanded metal.

Fig. 29 shows the control switching station at the northern end of the 240-mile tower line extending from Bishop to San Bernardino. Three separate systems are tied together at this point with an aggregate of 1185 miles of 55,000-volt line. The structures shown comprise the first unit of the extensive bus and switching plant that will ultimately be erected at this point. Fig. 30 shows the substation at the southern terminal of the 240-mile tower lines, the circuit entering the station through three-pole disconnecting switches mounted on towers in the foreground. The switches in the background are 33,000-volt and 55,000-volt automatic oil circuit-breakers for the control of the outgoing lines. To the left is the San Bernardino steam station, the turbo-generators of which float on the line at all times.

Fig. 31 shows an installation of 33,000-volt outdoor circuit-breakers. The latter, which are of the Kelman type, are shown in the foreground, and a 55,000-volt outdoor circuit-breaker of the same type is shown to the right. These circuit-breakers are provided with remote-control mechanism and with time-limiting devices on the overload trip. An auxiliary transformer bus is installed on the top of the frame, and by the use of the single-pole disconnecting switches, shown between the towers, it is possible to feed two adjoining circuits through one of the oil switches and to disconnect the other for inspection or repairs, thus eliminating the necessity for any interruption and at the same time maintaining protection to the main 33,000-volt bus against possibility of disturbance by trouble on the circuit from which the switch is removed.

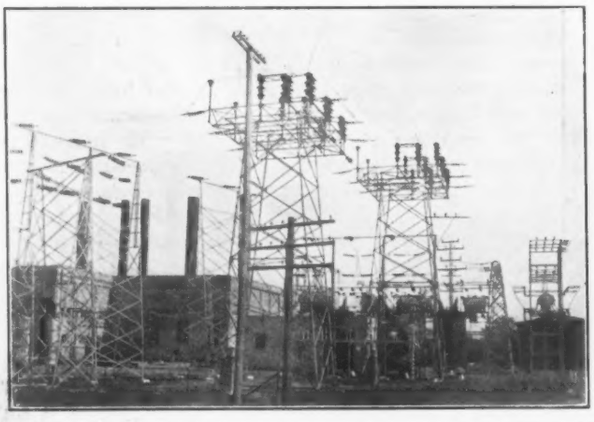


FIG. 30—SUBSTATION AT SOUTHERN TERMINAL OF 240-VOLT LINE OF SOUTHERN SIERRAS COMPANY

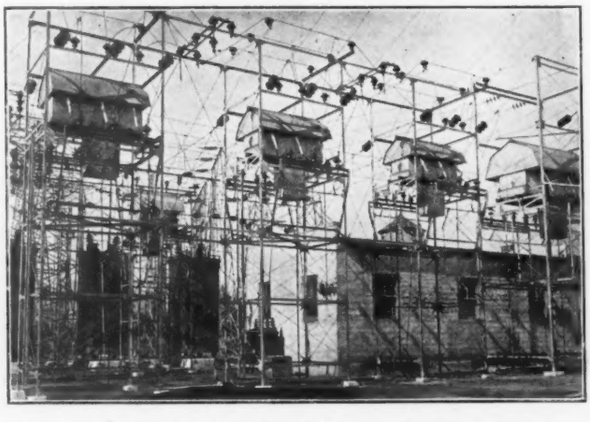


FIG. 31—INSTALLATION OF 33,000-VOLT OUTDOOR CIRCUIT-BREAKER

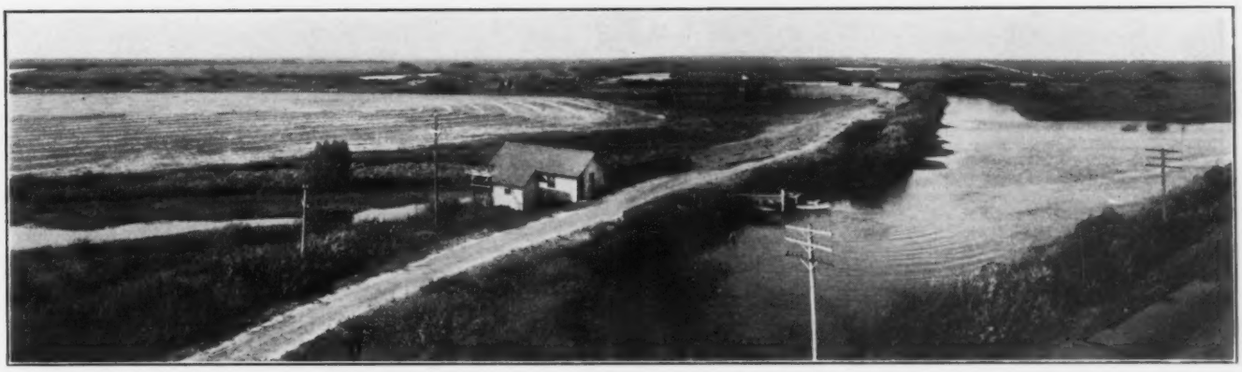


FIG. 1—ELECTRIC IRRIGATION ON ORWOOD RECLAMATION TRACT ALONG SAN JOAQUIN RIVER

Irrigation Pumping in the Coast States

Thousands of Acres of Western Lands Made Intensely Productive by Central-Station Service Which Has Desirable Seasonal Load Characteristics

PRINCIPAL in importance among the special motor loads served by the power companies of the Pacific Coast is electric pumping for irrigation purposes. Lands which were formerly indifferently productive or even hopelessly arid are, as the result of such artificial watering, rendered highly fruitful and of great value for orchards of citrus and other fruits, or for the growing of alfalfa and rice. To the central-station company this irrigation load has useful off-peak characteristics since the chief pumping demand comes during the months of restricted energy consumption for lighting.

Pacific Gas & Electric Company

The Pacific Gas & Electric Company being the largest utility west of Chicago and the greater part of its lines traversing the fertile Sacramento and upper San Joaquin valleys, the irrigation and reclamation loads on its system are naturally the largest to be found on the Pacific Coast. The development of the vast agricultural area of California has been most effectively aided by the use of electricity, and the gross earnings of the Pacific Gas & Electric Company from this service alone are practically $500,000 per annum.

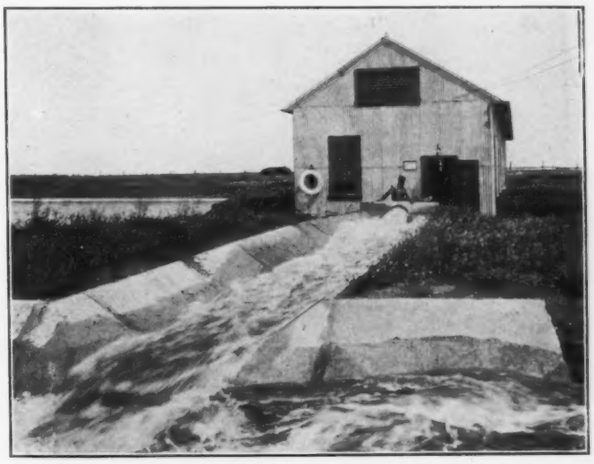
The irrigation load, while large, does not represent the major portion of the output of the Pacific Gas & Electric Company, as does the irrigation load of the Mount Whitney Power & Light Company, for instance, which requires over 80 per cent of that company's output. The possibilities of growth in the territory supplied by the Pacific Gas & Electric Company, however, are immense. At present the acreage served by the company's system is estimated at 400,000 acres, whereas the maximum amount of acreage subject to reclamation and irrigation in the territory contiguous to the company's lines is approximately 7,000,000 acres.

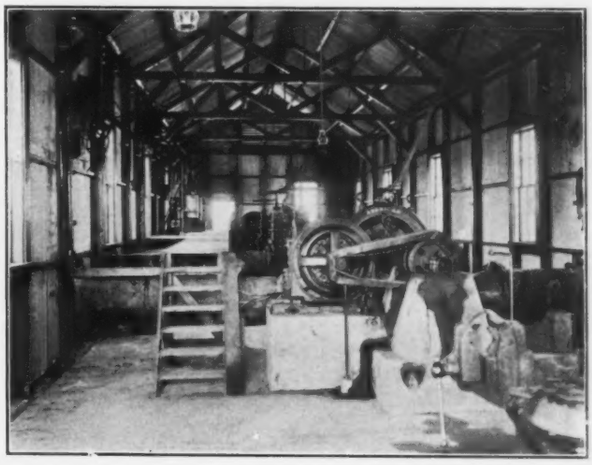
The greater part of the load is found in Solano, Yolo, Sacramento, Sutter and Santa Clara Counties, the connected irrigation load of these counties aggregating 20,000 hp. The density of this load is well shown in Fig. 11, indicating the irrigation outfits in the San José district. The load-factor of the pumping plants is also shown in the curves reproduced herewith, showing the substation output in the San José district.

Reclamation service in the lowlands along the Sacramento and San Joaquin Rivers gives promise of electrical applications in large units. At the present time there are connected to the circuits of the company approximately 15,000 hp in motors. That these represent large units is indicated by the fact that there are approximately eighty-eight installations.

The total irrigation load fed from the Pacific Gas & Electric Company's circuits is approximately 35,000 hp. The installations comprise, for the most part, centrifugal pumps directly connected to three-phase induction motors.

One of the most notable examples of large irrigation





FIGS. 2 AND 3—PUMP HOUSE ON PATTERSON RANCH IN STANISLAUS COUNTY—PACIFIC GAS & ELECTRIC SERVICE

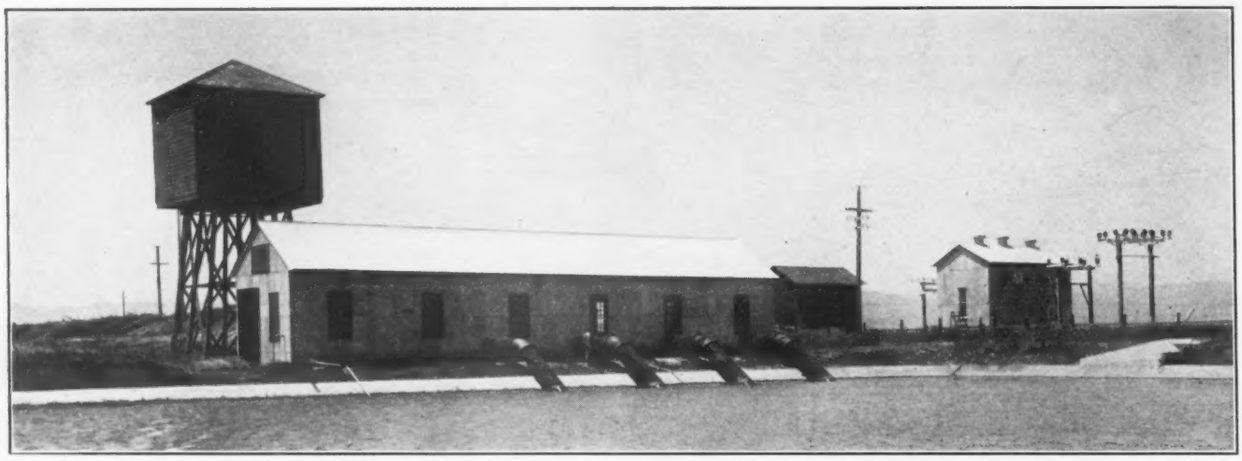


FIG. 4—HIGH-TENSION SUBSTATION AND MOTOR-DRIVEN PUMP HOUSE, PATTERSON RANCH

installations is that on the Patterson Ranch, in Stanislaus County, in the San Joaquin Valley. The total installation comprises five separate plants having a total rating of approximately 1700 hp. The water is pumped from the San Joaquin River to a total elevation of about 100 ft., the first plant, situated near the river, pumping 100 hp, each motor being directly connected to a centrifugal pump. Views of the Patterson ranch, canals and pump house are reproduced herewith.

Smaller installations, typical of those on orchards and farms, range from 5 hp to 20 hp. During approximately six months of the year these pumping stations

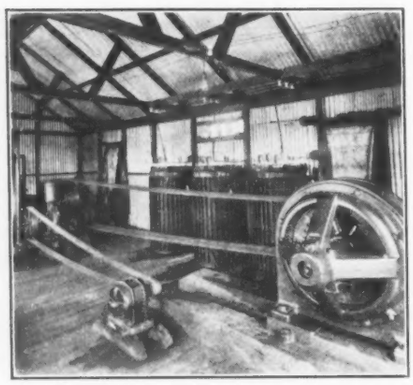


FIG. 5—INTERIOR OF VICTORIA ISLAND NO. 7 PUMPING STATION

FIG. 6—ELECTRICALLY DRIVEN GOLD DREDGE OPERATED FROM LINES OF PACIFIC GAS & ELECTRIC COMPANY

from the river into the main canal. A second plant is installed at the end of the main canal and lifts the water to the second canal, and this process is continued until the total elevation is reached. Ditches are extended from each of the canals, north and south, covering the different zones. The energy is brought to one central substation at 60,000 volts and from there distributed to the five pumping plants at 2300 volts, the motors being operated at this lower voltage. The motors in the various plants vary in size from 300 hp to

are used intermittently, pumping according to the requirements of the crop. The company's distributing circuits are brought to the nearest pole where the transformers are installed for stepping down to the low voltage required by the motor, and are continued thence to the service cut-out, which in a majority of cases is installed within the pump house.

Electricity for irrigation purposes is sold on a meter basis, the meters being installed on the low-tension side of the transformers in the pump house. The rates in

FIG. 7—DETAIL OF SUBSTATION ENTRY

FIG. 8—THE HEAD OF THE IRRIGATING CANAL

force on the company's system at this time vary from 3 cents per kw-hr. to 1¼ cents per kw-hr., with a minimum charge of $6 per hp per year.

The development of the rice industry within the past few years in the upper Sacramento Valley has provided practically 5 acre-ft. per season; for alfalfa, 2.5 acre-ft., and for orchards from 1.5 to 2.5 acre-ft. The cost of pumping per acre-foot of water will vary from $1.50 per acre-ft. up to $3, depending upon the height to which the water must be lifted.

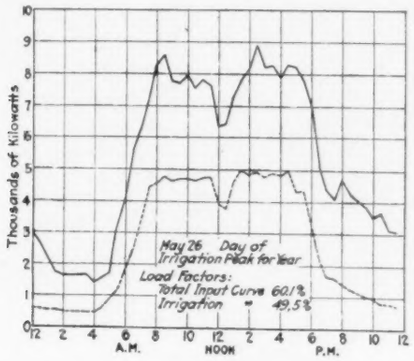


FIG. 9—CURVES SHOWING TOTAL LOAD AND IRRIGATION LOAD, SAN JOSÉ DISTRICT

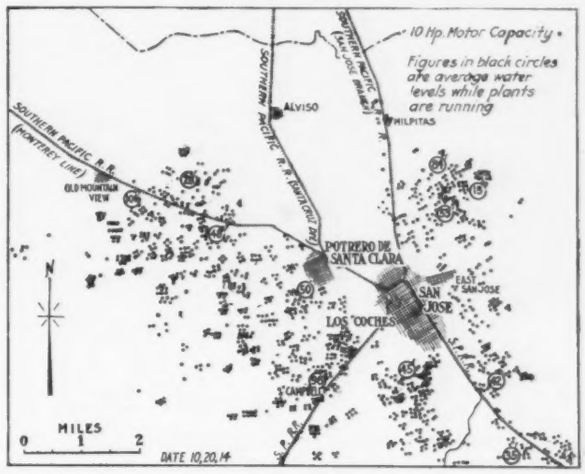


FIG. 11—MAP OF SAN JOSÉ DISTRICT, SHOWING DENSITY OF IRRIGATION LOAD

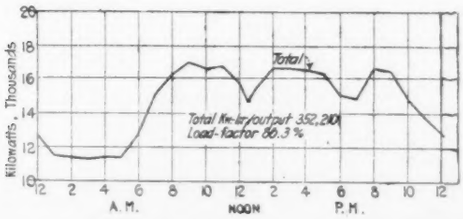


FIG. 10—SAN JOSÉ LOAD, SUMMER MONTHS

Pumping for reclamation purposes in fertile lands along the Sacramento and San Joaquin Rivers is made necessary because the lands lie below the level of the water in the river during a large portion of the year. For this reason it is necessary to get rid of the rain water and also the water that seeps through the levees surrounding the tracts. It has been found that the crop return in the reclaimed districts is very much increased by irrigation in the summer time. This is accomplished

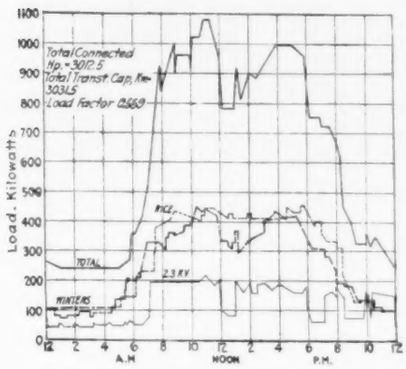


FIG. 12—DAILY LOAD, SOLANO DISTRICT

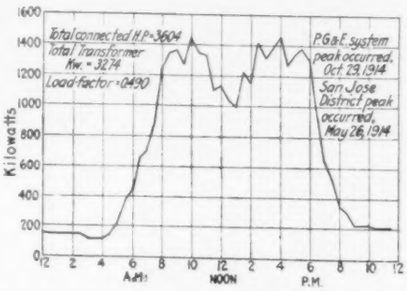


FIG. 13—DAILY LOAD CURVE, SAN JOSÉ DISTRICT

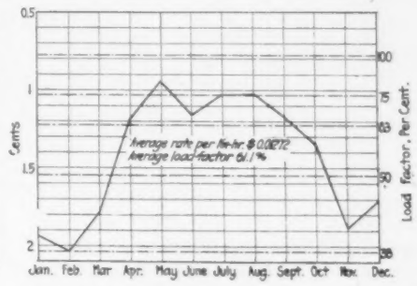

Cents
Load Factor, Per Cent.
Average rate per kw-hr. $ 0.0072
Average load-factor 61.1%
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct Nov. Dec.

FIG. 14—AVERAGE LOAD-FACTORS AND RESULTING EQUIVALENT RATES

a very satisfactory irrigation load, the amount of water required for rice being roughly twice that required for alfalfa, the next best crop for irrigation. Rice, in addition, offers a better load-factor, because after the rice is harvested the rice mills take up their work. In ordinary practice the amount of water required for rice is by gravity, and since the land is below the level of the rivers, in order to drain it the surplus irrigation water must be pumped over the levees. These fertile delta lands are particularly adapted to the growing of asparagus, potatoes, onions, beans and celery, all of which crops are produced in great abundance. After reclama-

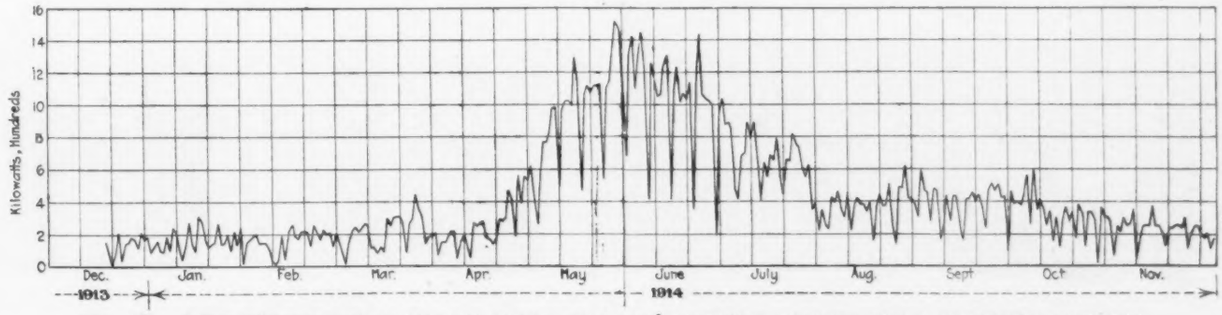


FIG. 15—DAILY CIRCUIT PEAKS FOR ONE YEAR, SAN JOSÉ DISTRICT, PACIFIC GAS & ELECTRIC COMPANY

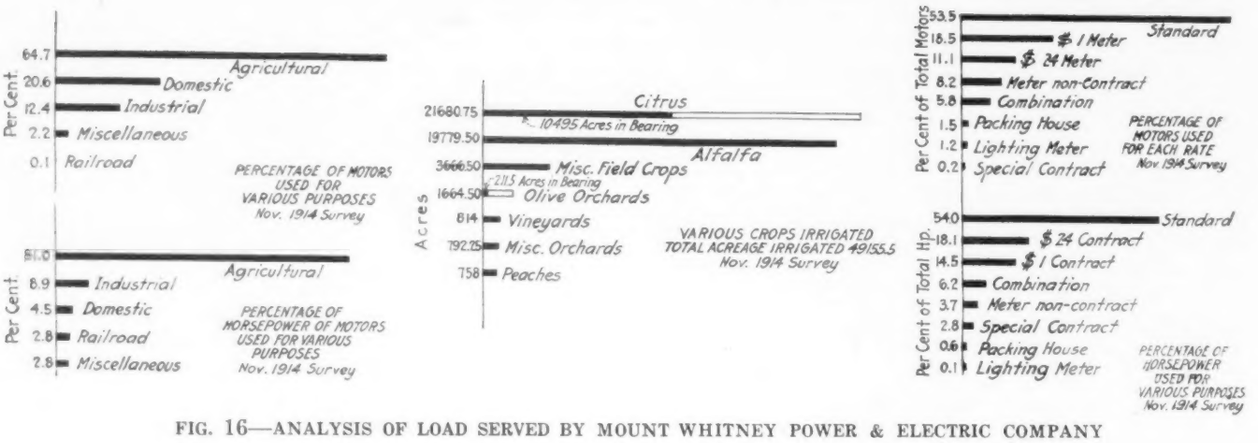


FIG. 16—ANALYSIS OF LOAD SERVED BY MOUNT WHITNEY POWER & ELECTRIC COMPANY

tion has been carried on for a few years alfalfa and grain can be planted. Barley, in particular, returns a very heavy yield on this kind of land.

Mount Whitney Power & Electric Company

The Mount Whitney Power & Electric Company owns four high-head hydroelectric generating stations with a combined rating of 13,000 hp and a steam plant located in Visalia rated at 10,000 hp.

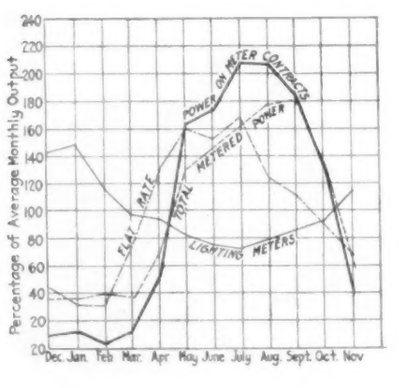
Of the territory served Tulare County forms the largest part. This is in the southern portion of the San Joaquin Valley and extends to the east over the foothills into the high Sierras. From a sparsely settled area of large farms it has steadily developed into one of the important citrous and deciduous fruit-growing sections of California. Intensive farming, brought about by an abundant water supply with cheap energy for pumping purposes, has resulted in a wide diversity of agricultural products. Fully one-third of the farm homes in Tulare County are using electricity supplied by the Mount Whitney Power & Light Company and are on land that in 1900 was regarded as hopelessly arid.

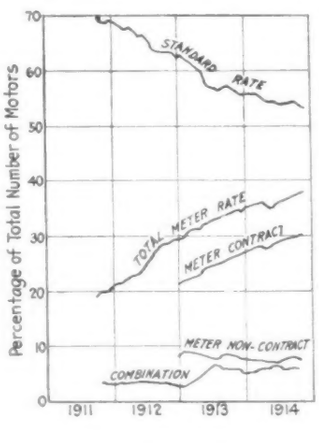
Energy is used largely for pumping water for irrigation from ground water in the citrous fruit belt. Many large orange, lemon and other orchards in the vicinity depend upon the electricity generated by the company's present plants for their irrigation. The region thus far has been developed from one of large farms to one of small holdings devoted to fruit raising. In December, 1914, the horse-power in motors connected to the system of the company was divided as follows: Agricultural, 81 per cent; domestic, 4 per cent; industrial, 9 per cent; railroad, 3 per cent; all others, 3 per cent. There were 49,153 acres irrigated by the motor-driven pumping plants to which the company supplied energy. The crops irrigated covered these acreages:

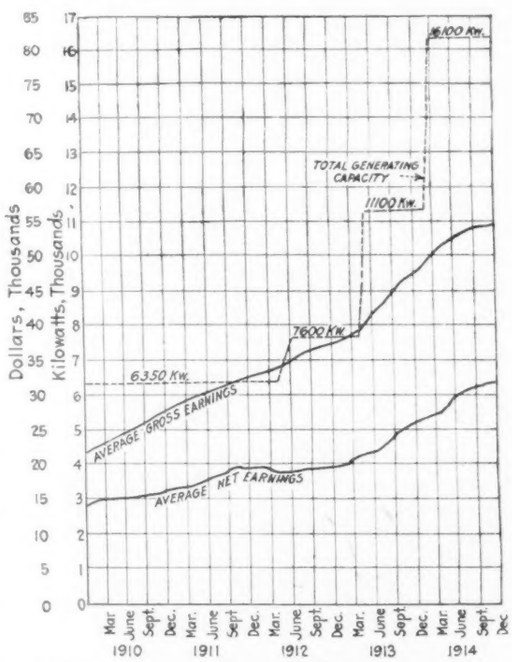
Citrus orchards (bearing)	10,522
Citrus orchards (non-bearing)	11,106
Olive orchards (bearing)	211
Olive orchards (non-bearing)	1,463
Peach orchards	758
Other orchards	792
Vineyards	814
Alfalfa	19,758
Miscellaneous crops	3,729

The principal load consisting of motor-driven pumps, certain peculiarities in construction prevail. Each pumping plant consists of a small building in which is placed either a centrifugal or a deep-well plunger pump driven by an induction motor. The plants near the foothills, where the water is some distance beneath the surface, have deep-well pumps, while in the valleys, where the water is nearer the surface, centrifugal pumps are employed. The motors in all cases are of the two-phase induction type rated at from 1 hp to 75 hp. Local distribution in all of the towns is at 2200 volts, two-phase, with the exception of the city of Visalia, where distribution is carried out on three-phase circuits. Two types of distribution lines are used. The one covering the greater part of the distribution system operates at 6600 volts, and the other, for towns and cities, at 2200 volts.

From the commencement of operations the company established a rate for energy for motors of $50 per hp-


Percentage of Average Monthly Output
POWER ON METER CONTRACTS
TOTAL METERED POWER
FLAT RATE
LIGHTING METERS
Dec. Jan. Feb Mar. Apr May June July Aug. Sept. Oct. Nov





FIGS. 17, 18 AND 19—ANALYSIS OF CUSTOMERS, RATES, OUTPUT AND EARNINGS, MOUNT WHITNEY POWER COMPANY

GRIPPER SIDE GUIDE

year, and while it is possible at this rate to use the energy day and night throughout the year, the pumping plant seldom uses energy steadily for more than eight months of the year. This average use brings the rate for pumping to approximately a little over 1 cent per kw-hr., while if the customer employs the electricity for lighting when it is not otherwise used for pumping (which is allowable), the average rate is still lower. The rate applies as well to a 1-hp motor as to the larger sizes. The elements leading up to the adoption of the rate of $50 per hp-year were many. The first Niagara Falls plant sold its output upon a peak-load basis, thereby securing a dependable income, and as the Mount Whitney company had no available resources except the income derived from the system, it seemed desirable that it should make the business as safe as possible. If it had not been for plant diversity factor, a feature not fully considered because not fully understood, the rate would have been too low for profitable operation. As a further inducement to get the consumers to operate their pumps by motors instead of by engines of various types, it was agreed that when a motor was not being used to pump water the house of the consumer could be illuminated at no additional expense, provided that a switch was installed which would make it impossible to operate the motor and use the lamps at the same time, and provided also that the energy used for lighting did not exceed the amount required by the motor. For several years contracts for energy for motors to be used between sunrise and sunset were made, the charge being $30 per hp-year. This contract was discontinued, however, in 1907, and a meter rate for commercial purposes was introduced by the company. Flat rates for lighting were abolished the year before. Later a meter rate for pumping was made, while as early as 1903 a combination of a flat rate and meter rate was put into effect for motors used for pumping water. The flat rate of $50 per hp-year is used very generally, however, for pumping purposes.

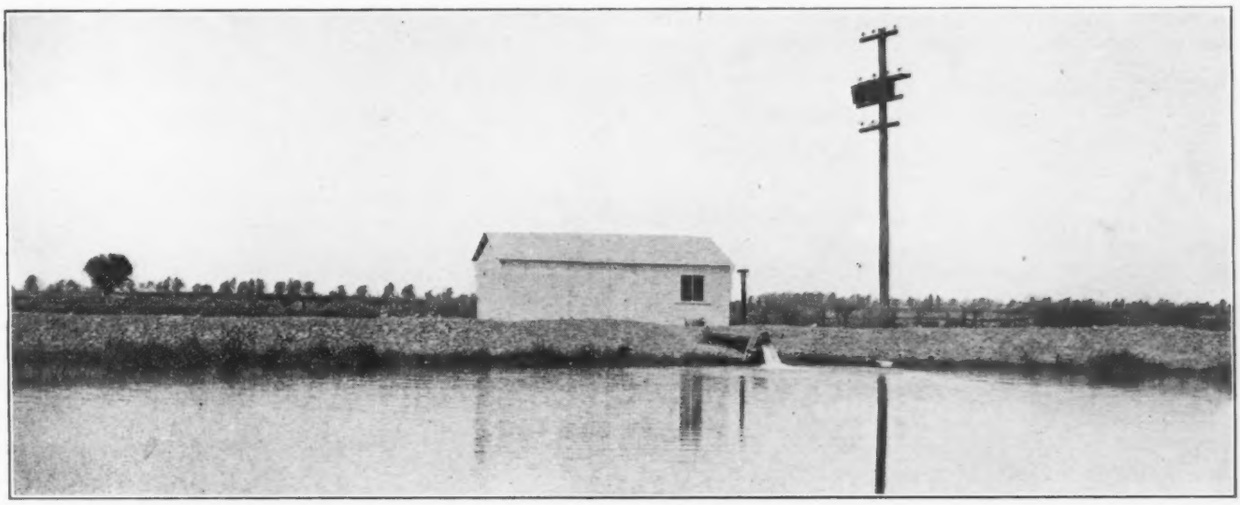


FIG. 20—PUMPING INSTALLATION ON SYSTEM OF SAN JOAQUIN LIGHT & POWER CORPORATION

San Joaquin Light & Power Corporation

During the past ten years, and more especially during the past five years, great strides have been made in the development of an irrigation load in the territory of the San Joaquin Light & Power Corporation, and this load has been especially beneficial to the company because it could dispose of its energy during a period of the year when it had a very large surplus. Because the San Joaquin Valley has comparatively few large industrial plants the central stations therein were at first compelled to dispose of the largest part of their output for lighting purposes, thereby creating a very "peaky" load, which resulted in the daily peak being on some occasions as much as three times the minimum load of the day. Owing to this fact, and also to the fact that in the San Joaquin Valley there are 6,530,000 acres of valley agricultural land, the San Joaquin Light & Power Company turned its attention toward the development of an irrigation load that would vastly improve the plant load-factor and permit it to dispose of its surplus energy.

The territory served by the company's circuits is approximately 200 miles long and 54 miles wide, and there are now being fed from the system 700 pumping plants with a connected load of 8650 hp. The gross earnings from this load are approximately $260,000 per annum, and the pumping plants are irrigating slightly over 100,000 acres.

It will be evident that the development of the agricultural land in the San Joaquin Valley by means of electrically operated pumping plants is very slight, but it will require a vast amount of effort, together with heavy expenditures of money, to develop all the irrigating load to be had.

The electrical energy is transmitted to the several substations at 60,000 volts, although there are still some 30,000-volt mains which will be gradually replaced. The tension is stepped down at each substation to 11,500 volts and distributed therefrom three-phase, sixty-cycle, three-wire flat construction on 30-ft. and 40-ft. poles, the main trunk lines being of 40-ft. poles and No. 4 wire and the side lines of 30-ft. poles and No. 6 wire. The cost of the former is approximately $900 per mile and that of the latter $800 per mile.

It is the practice of the San Joaquin company to extend the line at its expense to within 20 ft. or 30 ft. of the pumping plant to be served. The transformers are furnished by the consumer (the rates are based upon the consumer furnishing the step-down transformers), and they are of the 6600-volt type, connected "Y." The transformers are installed by the company on the pole nearest the pumping plant, and the cost of installing the service wires from the transformers to the motor is borne by the consumer. However, the work is usually performed by the company's workmen at the time the line is constructed. A large majority of the pumping plants installed are of the horizontal type, with the pump directly connected to a motor installed at the bottom of a pit and within some 2 ft. or

3 ft. of the water in the well. There are a number of pumping plants, however, of the vertical type, wherein a vertical motor is installed on a steel frame on the surface of the ground and connected to a vertical pump by means of a long shaft suspended from a steel frame. Some of the latter types of plant have motors rated at from 75 hp to 100 hp.

The size of tract to be irrigated and the nature of the soil, together with the kind of crops to be raised, determine the amount of water to be pumped. It requires from 3½ gal. to 6 gal. of water per minute per acre, the smaller tracts of sandy soil requiring the greatest amount per acre. The pumping plant is operated twenty-four hours a day, and the water is impounded in a reservoir near the well. The actual irrigation of the tract takes place during a period of ten hours between sunrise and sunset. By impounding the water and operating the pumping plant twenty-four hours per day and irrigating only ten hours, a head of water is obtained from the reservoir that is approximately two and one-half times the capacity of the pump. The reservoir holds approximately a twenty-hour run of his district. The pumping outfits, including motors, are sold to the customers by agents of pump manufacturers, and the pump companies very often employ electricians to connect the motors. Contracts for the operation of the pumping plants by the company are for a term of five years.

Fig. 20 shows a pump house, reservoir and transformers of a customer having a six months' contract for continuous pumping during that period. The detailed costs pertaining to the plant are as given below: This serves to show what land can be irrigated for and what the costs of preparation are:

Size of plant, hp	20
Wells, number	3
Wells, diameter, in.	10
Depth of wells, ft.	39, 76, 95
Cost of wells	39-ft., $55; 76-ft., $107; 95-ft., $135
Size of pump, in.	7
Gallons per minute	1500
Pumping head, ft.	30
Input to motor, hp	19.9
Cost of wells, motor, pump, transformers, installed, ready for use	$1,350.00
Size of reservoir, ft.	240 by 280 by 5

FIG. 21—PUMP HOUSE IN THE EASTERN WASHINGTON TERRITORY SERVED BY PACIFIC POWER & LIGHT COMPANY

the pump and is built cheaply by throwing up a levee with scrapers.

The charges for service are entirely on a flat-rate basis, except that a meter rate is quoted during the planting period, not to exceed, however, two years, and then follows the flat-rate charge. The most popular rate quoted is $50 per hp per year for continuous service throughout the year. In some parts of the San Joaquin Valley and for some crops a flat rate for six or seven months' continuous pumping is used, the six months' rate being $37.50 per hp and the seven months' rate $40.25 per hp. The horse-power to be charged for is determined by taking the peak for a continuous period of five minutes during the irrigating term. Tests are made by the company from time to time while the pumping plant is in operation, and the highest amount ascertained at any of such times is the amount to be charged for, the tests being taken over a period of five minutes' duration.

The territory served by the company is divided into twelve districts, and each district is presided over by a representative called the district agent. All of the consumers' accounts are kept in the district offices, and there is also a storeroom in each district. The soliciting is done by the district agent, who also has control over the building of the lines, collection of the bills and, in fact, over all of the affairs of the company in

Cost of reservoir	$125.00
(Reservoir was enlarged this spring to 290 ft. by 280 ft. by 5 ft. at a cost of about $50.)	
Cost of pit	$225.00
(Too large; could have been built proper size for $150.)	
Acres irrigated	240
Crop raised	Alfalfa
Contract	Six months continuously
Total cost in 1914	$746.40
Cost per acre	$3.11
Kw-hr. used in 1914	58,896
Resulting rate per kw-hr., cents	1.27
(Open ditches used; one man irrigated 240 acres at cost of $2.65 per day.)	

Pacific Power & Light Company

The Pacific Power & Light Company and its predecessors were the first to develop the electric pumping business in Washington and Oregon on an extensive scale. The industry has been brought to its highest development in the Yakima, Columbia and Walla Walla River valleys. The installations vary from 0.5 hp to 800 hp, though the majority are of 10 hp and less. In some cases special substations have been built for large customers who are served directly from 66,000-volt transmission lines, but generally the installations are connected to the 6600-volt lines that the company has constructed throughout its rural territory. In the summer of 1914 the company had a total of 4952 hp in irrigation motors connected to its system.

The Yakima and Columbia River valleys depend almost entirely upon irrigation for the successful production of crops. The Walla Walla River valley has sufficient rainfall to produce some crops without irrigation so that the development of irrigation pumping is not so extensive in the Walla Walla territory as in the other

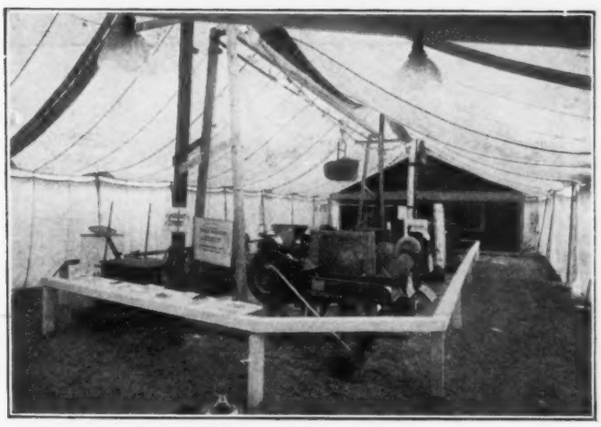


FIG. 22—FARM ELECTRICAL APPARATUS AT A FAIR

districts. As a general rule, the Walla Walla farmers use their pumping rigs about three months of the year, whereas the other irrigators pump for a six months' season.

In talking irrigation pumping to the average farmer several arguments are of importance. One of these is that individual pumping permits well water to be used. Well water is highly desirable, for the reason that the farmer has absolute control over his supply, provided, of course, that the well has sufficient flow. Well water that is seeped through the soil is clarified and does not carry sand, grit, weed seeds or trash. Few Eastern people realize to what great extent weeds are scattered through cultivated areas by irrigation water. Each seed is a potential nuisance, and water represents one of its greatest means of transportation.

The well pumper is not a member of a ditch company. He can use his pump and well whenever he wants to and does not have to wait while his crops suffer for moisture. Reliability of service favors the electric motor as against the gasoline engine, particularly in some parts of the Northwest where lack of transportation facilities causes gasoline to be very expensive. The Pacific Power & Light Company has proved to its own satisfaction that electrically driven pumping outfits for passable heads are cheaper in the long run than the average gravity system with its expensive outlay for water rights. As a general rule, the irrigation in the Yakima and Columbia River districts is from dug wells which are of average cross-section. The company engineers check over installations with prospective customers, showing them how they can get the best efficiency by sinking their wells near the center of distribution. The Pacific Power & Light Company has always followed the policy of giving all the engineering experience it can to its customers. In building up this class of business attention should be called to the fact that the farmers must be urged to order their apparatus in plenty of time for spring irrigating. Many farmers fail to realize the time required to manufacture, ship and install apparatus.

For practical purposes there are two types of pumping outfits—directly connected and belted. The arguments in favor of the belted type are that during winter months the motor may be used for other purposes, although it has the disadvantage of lower efficiency than the directly connected pump. The experience of the Pacific Power & Light Company has demonstrated that but few farmers take advantage of the opportunity to disconnect belted motors and use them for other purposes. Most farmers seem to prefer a directly connected outfit and purchase such other motors as they may need. This is particularly true in cases where motors are needed for other purposes during the summer when they could not be spared from irrigation service.

The company has endeavored to work out a practical application of the group system whereby a small number of farmers may band together and put in one installation the use of which can be rotated among them. This has the advantage of permitting the farmer to receive a large volume of water every third day instead of receiving a small volume of water every day. Persons who have had practical experience as irrigators know that they must have a certain volume of water which will provide them with what is known as an "irrigation head" before they can accomplish anything.

DATA ON MOTOR PERFORMANCE

	Maximum	Minimum	Average
2-hp motors:			
Acres irrigated	25	9	12
Acres irrigated per hp	12½	4½	6.2
Cost per acre-year	$9.46	$3.02	$5.20
3-hp motors:			
Acres irrigated	37½	9	18
Acres irrigated per hp	12⅔	3	6
Cost per acre-year	$9.38	$3.35	$5.82
5-hp motors:			
Acres irrigated	50	5	23
Acres irrigated per hp	10	1	4½
Cost per acre-year	$14.06	$3.24	$7.00
7.5-hp motors:			
Acres irrigated	77	8	38
Acres irrigated per hp	10	1	5.2
Cost per acre-year	$15.55	$3.50	$7.50
10-hp motors:			
Acres irrigated	70	20	44
Acres irrigated per hp	7	2	4½
Cost per acre-year	$10.97	$3.46	$6.86
15-hp motors:			
Acres irrigated	112	80	100
Acres irrigated per hp	7	5	6.6
Cost per acre-year	$5.76	$3.21	$4.43
20-hp motors:			
Acres irrigated	150	20	103
Acres irrigated per hp	7½	1	5
Cost per acre-year	$19.37	$3.97	$9.39

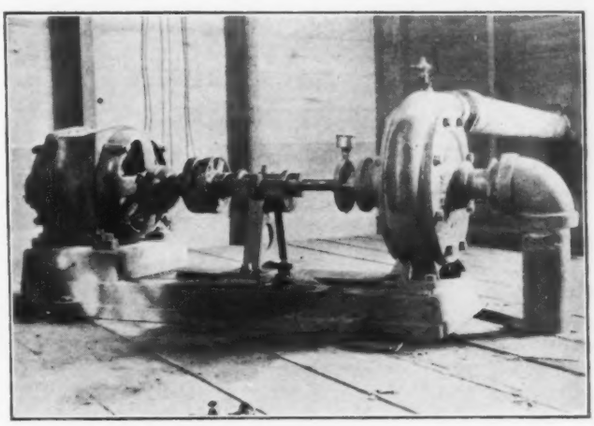


FIG. 23—A 3-HP MOTOR UNIT NEAR ZILLAH

A small stream of water may not even wet the furrow, whereas if a farmer had three times as much water he would need to apply only one-third of the time. There have been a few instances of successful group systems, and more of them may be developed. The only difficulties in the way of the group system are the possibility of the irrigators disagreeing as to the use of the

plant and also the fact that it is rather unusual for three farmers in one neighborhood to require exactly the same-sized installation, although the latter drawback is not a serious one.

The company has adopted a uniform system of extending its 6600-volt distribution wires and installing transformers for a prospective load of 10 hp to the mile. While 10 hp may not look particularly profitable at first sight, yet at the end of two or three years more business probably will be developed along the existing lines. The company requires at least a ten-year contract. Its irrigation experts make frequent inspections and do their best to aid the irrigators.

In order to show some of the actual results obtained, the company prepared some statistics a year ago, showing the performances of various sized motors from 2 hp to 20 hp. These results are given in the table printed herewith. Under "2-hp motors" it will be noted that the maximum number of acres irrigated by any 2-hp motor was twenty-five and the minimum was nine, the average being twelve. The maximum number of acres irrigated per horse-power was twelve and one-half and the minimum four and one-half, with an average of six and one-fifth. The figures opposite "Cost per acre-year" are self-explanatory. The reader is cautioned, however, to take note of the fact that the figures presented under the heading "2 hp" include a large number of 2-hp motors, and the motor that irrigated the maximum number of acres may or may not be the one that cost the most per acre-year. In fact, it is very apt to be quite the opposite. In other words, the 2-hp motor that irrigated twenty-five acres probably did so at the average cost of $3.02. This table has been published before, and readers have been confused, thinking that the set of figures under the heading "Maximum" represented the operation of one particular motor. This is not the case. In preparing the table the company purposely eliminated the pumping customers in the Walla Walla district for the reason that they are short-season irrigators and do not represent general conditions.

Great Western Power Company

The Great Western Power Company has an extensive irrigation load on its system, especially in the Sacramento district; but the average load-factor is very low so that the company is not over-enthusiastic on the subject. It has approximately 8000 hp of this business connected to its circuits that returns an average yearly minimum of less than $7 per hp per annum. In sharp contrast to this, the company has a gold-dredging load of 9000 hp with an annual load-factor of 70 per cent. The rate for irrigation service varies from 3 cents per kw-hr. for a monthly consumption of less than 31 kw-hr. per hp to 1 cent for consumptions of 540 kw-hr. per hp. The minimum is $6 per hp. per annum, and only a few of the agricultural consumers exceed this minimum. The data on irrigation in the Sacramento district are given in the accompanying table.

IRRIGATION LOAD IN SACRAMENTO DISTRICT

Class	Annual Average Kw-hr. per Hp	Revenue at 3 Cents	Average Annual Load-Factor, per Cent
Grapevines	383	$11.49	5.0
Trees and garden	156	4.68	2.0
Alfalfa, trees, vines	175.4	5.26	2.3
Garden trees	265	7.92	3.5
Alfalfa, trees	466	13.98	6.1
Orchard	140	4.20	1.8
Alfalfa	165	4.95	2.1
Truck garden	111	3.33	1.4
Vines and berries	374	11.22	4.4
Vines and trees	213	6.40	2.8
Strawberries	259	8.77	3.8
Oranges	67	2.01	0.9

The Southern Sierras Power Company

A large percentage of the business of the Southern Sierras Power Company, especially in southern California, is furnishing electrical energy for irrigation. Entering the field in the summer of 1912, gas engines were displaced, and but few new gas engines installed, so that to-day in that portion of Riverside and of San Bernardino Counties served by and within reach of the lines of the company the percentage of gas engines operating, even with the abnormally low price of "tops," is merely nominal.

The company has provided a variety of optional rates. First are straight kilowatt-hour rates, similar to those found in southern California at the time it entered the field. These original rates decrease with the size of the installation and encourage large installations. They have since been modified so as to encourage smaller plants. These rates range from 3 cents to 2 cents per kw-hr. Second are load-factor schedules, varying in rates from 3 cents to 1 cent per kw-hr., and, third, come flat rates per horse-power per year, similar to those in vogue in the San Joaquin Valley, ranging from $27 per hp of maximum demand for four months per season, with a metered charge of 2½ cents per kw-hr. for excess service, to $50 per hp of maximum demand for twelve months' continuous service per year.

The schedules, being optional, afford low rates for a wide range of operating conditions. Gradually the tendency is shifting to the flat rate per horse-power per year. This provides the smallest possible installa-

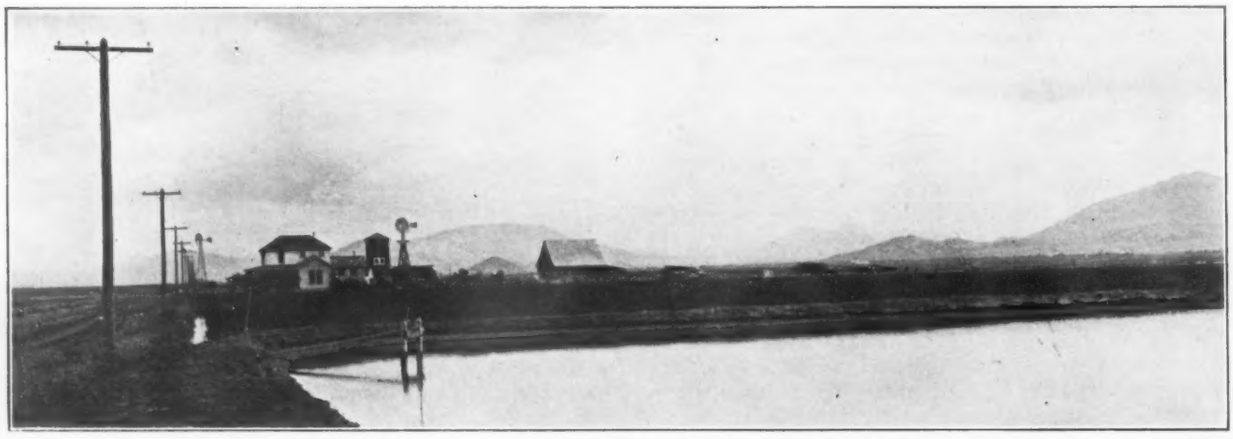


FIG. 24—TYPICAL RESERVOIR CONSTRUCTION IN RANCHING DISTRICT, SOUTHERN SIERRAS SYSTEM

tion for the greatest aggregate volume of irrigation, serving the twofold purpose of reducing to a minimum the consumer's first cost for installation, as well as his operating cost per annum, and at the same time improving the load-factor of the company, so that a maximum of service can be provided from a given generating transmission and distributing system.

Following are a few concrete examples of actual operating conditions under different schedules:

CASE NO. 1:

Number of acres owned	107
Number of acres under cultivation	106
Crop	Alfalfa

WELL DATA

Water depth from surface, ft	93
Suction lift, ft	25
Friction head, ft	3
Lift above surface of ground, ft	6
Total head, ft	127
Number of wells	2
Diameter of wells, in	12
Depth of wells, ft	250
Depth of pit, ft	91
Length of pit, ft	7
Width of pit, ft	6

(Pump and motor are installed in a pit, and both wells are served by the one pump.)

PUMP AND MOTOR DATA

Pump:	
Make	Byron-Jackson
Kind	Centrifugal
Style	Horizontal two-stage
Amount pumped	600 g.p.m.
Motor:	
Make	Fairbanks-Morse
Type	Induction
Style	Horizontal
R.p.m.	1200
Voltage	2200
Phase	Three
Frequency	60
Hp	40

PLANT DATA

Number of hours pumped during season	5000
Number of acre-feet pumped during season	515
Input to motor (40 hp), kw	29.8
Kw-hr. per season	149,000
Schedule rate (flat rate, seven months' pumping period), per hp	$42.00
Amount of bill for season	$1,680.00
Cost per kw-hr., cents	1.12
Cost per acre-foot	$3.26
Cost per acre	$15.85

Remarks: This pumping plant is jointly owned by two persons. One ranch consists of 50 acres and the other of 57 acres. One acre is taken out for pumping plant.

CASE NO. 2:

Number of acres owned	80
Number of acres under cultivation	80
Crop	Alfalfa

WELL DATA

Water depth from surface, ft	50
Suction lift, ft	27
Friction head, ft	12
Lift above surface, ft	20
Total head, ft	109
Number of wells	1
Diameter of wells, in	14
Depth of wells, ft	300
Depth of pit, ft	45
Length of pit, ft	8
Width of pit, ft	6

PUMP AND MOTOR DATA

Pump:	
Make	Byron-Jackson
Kind	Centrifugal
Style	Horizontal two-stage
Amount pumped	675 g.p.m.
Motor:	
Make	General Electric
Type	Induction
Style	Horizontal
R.p.m.	1800
Voltage	2200
Phase	Three
Frequency	60
Hp	35

PLANT DATA

Number of hours pumped during season	5000
Number of acre-feet pumped during season	650
Input to motor (32 hp), kw	23.8
Kw-hr. per season	138,990
Schedule rate (flat rate, eight months' period), per hp	$45.00
Amount of bill for season	$1,440.00
Cost per kw-hr., cents	1.02
Cost per acre-foot	$2.02
Cost per acre	$18.00

CASE NO. 3:

Number of acres owned	100
Number of acres under cultivation	100
Crop	Alfalfa

WELL DATA

Water depth from surface, ft	45
Suction lift, ft	20
Friction head, ft	7
Lift above surface of ground, ft	6
Total head, ft	78
Number of wells	1
Diameter of wells, in	12
Depth of wells, ft	210
Depth of pit, ft	42
Length of pit, ft	8
Width of pit, ft	6

PUMP AND MOTOR DATA

Pump:	
Make	Krogh
Kind	Centrifugal
Style	Horizontal single-stage
Amount pumped	450 g.p.m.
Motor:	
Make	Fairbanks-Morse
Type	Induction
Style	Horizontal
Phase	Three
Frequency	60
Hp	10

PLANT DATA

Number of hours pumped during season	5000
Number of acre-feet pumped during season	385
Input to motor (18.8 hp), kw	14.0
Kw-hr. per season	70,000
Schedule rate (flat rate, seven months' period), per hp	$42.00
Amount of bill for season	$789.00
Cost per kw-hr., cents	1.12
Cost per acre-foot	$2.05
Cost per acre	$7.89

Remarks: Use is made of a reservoir 135 ft. by 150 ft. by 5 ft. deep. The outfit pumps into this at night, and the water is discharged in the daytime. The pumping plant is 4750 ft. distant from the reservoir. An attendant visits the pumping plant once a week to inspect it, the pump being oiled from a 5-gal. can of oil.

Fig. 24 shows a typical reservoir constructed in the large ranching area served by the Southern Sierras Power Company in southern California. These reservoirs are constructed with a minimum of expense to the rancher, and he is encouraged to make use of one by the fact that exceptionally low rates are made on the flat rate per horse-power-year basis.

Fig. 25 shows a complete installation for serving customers from the 33,000-volt distributing lines of the company. In this particular instance three 50-kva., 33,000-to-2200-volt transformers serve one ranch having three pumping plants. The entire consumption is metered at the transformers, a 2200-volt metering equipment being installed in the meter box shown at one end of transformer structure. This box is padlocked and provided with small windows through which the meter dials can be read.

Fig. 28 shows two Gould triplex pumps that are used as boosters. These pumps lift the water delivered to

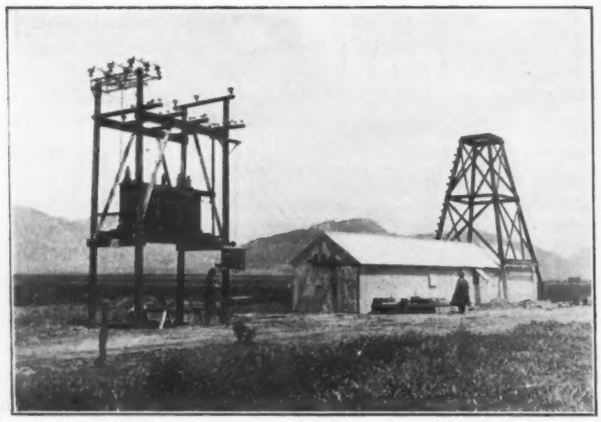


FIG. 25—CUSTOMER'S SUBSTATION ON 33,000-VOLT LINE OF SOUTHERN SIERRAS SYSTEM

them by a centrifugal pump to a height of 140 ft. in connection with the extensive irrigating system of a large ranch.

Fig. 26 shows the motor-control panels in the same plant for two 50-hp motors and one 20-hp motor. These motors, in line with the standard practice of the Southern Sierras Power Company, are wound for 2200 volts. All such control equipment is protected by substantial gratings, as shown.

Fig. 29 shows plant No. 3 of the Newport Ranch, with a Byron-Jackson centrifugal pump driven by a 50-hp, 2200-volt, 900 r.p.m. vertical-type induction motor. The pump is 48 ft. below the motor in a pit. Attention is called to substantial structural-steel frame for supporting the motor and guides. It will be noticed that the pump mechanic has fitted up an oiling system of ample capacity to protect the pump during his absence from the plant. The motors are protected by overload and no-voltage devices, and one man will ordinarily care for two or three plants.

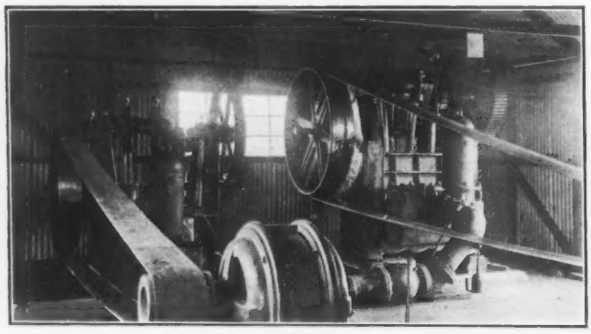


FIG. 28—TRIPLEX PUMPS USED AS BOOSTERS FOR CENTRIFUGAL PUMP LIFTING WATER 140 FT.

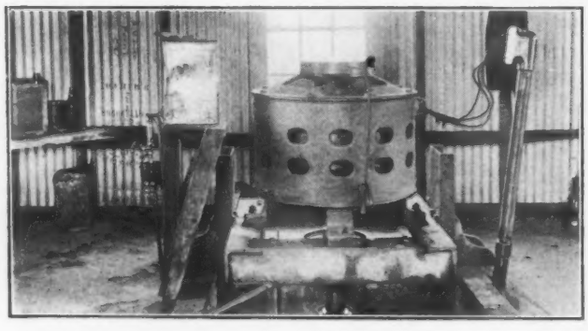


FIG. 29—VERTICAL-SHAFT 50-HP MOTOR IN NEWPORT RANCH STATION—SOUTHERN SIERRAS COMPANY

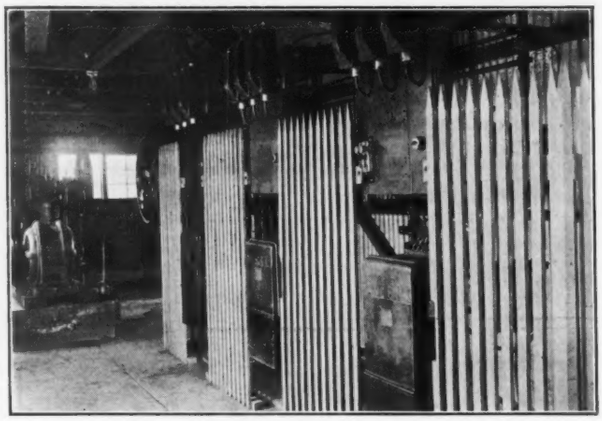


FIG. 26—MOTOR-CONTROL PANELS, NUEVO LAND & WATER COMPANY'S PUMPING STATION

Pacific Light & Power Corporation

The Pacific Light & Power Corporation operates in the city of Los Angeles and contiguous territory. Its chief load is obtained by the street and interurban railways in and radiating from Los Angeles. The largest single class of business employing motors outside of the railway field and connected to the company's circuits is irrigation. The crops are similar to those

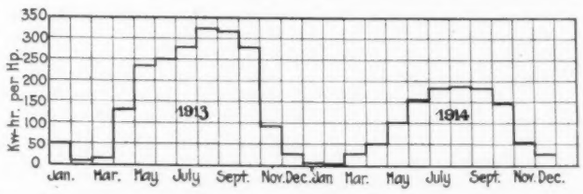


FIG. 27—MONTHLY ENERGY CONSUMPTION FOR YEARS OF SUBNORMAL AND ABNORMAL RAINFALL

raised in orchards and farms supplied with electricity from the circuits of the Southern California Edison Company. The accompanying curve shows the monthly average kilowatt-hours per horse-power of connected load for irrigation services, and also shows how the use of electricity for irrigation purposes is affected by the rainfall in the region. During dry years more electricity is of necessity employed in irrigation work than during years when the rainfall is normal or above normal.

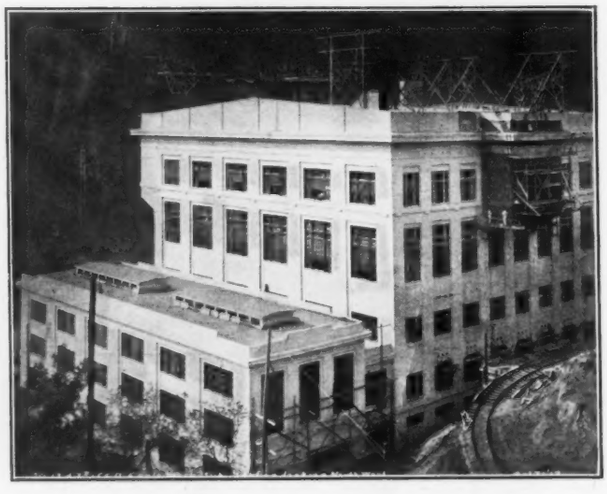


FIG. 30—EAGLE ROCK SUBSTATION, PACIFIC LIGHT & POWER CORPORATION

COMMERCIAL SECTION

COMMERCIAL PRACTICES IN CALIFORNIA

The Selling System That Operates Throughout the Vast Pacific Electric Territory and How It Was Evolved

BY H. B. PITTS*

The Pacific Gas & Electric Company furnishes gas and electricity to customers in 225 cities and towns in central California, among the largest communities being San Francisco, Oakland, Berkeley, San José and Sacramento, the last-named being the capital of the state. Its ten hydroelectric plants are situated at various points in the Sierra Nevada Mountains. Its four steam plants are at San Francisco, Oakland, Sacramento and San José. From these generating stations its lines extend over an area one-half the size of all the New England States combined, supplying 152,000 consumers with electricity, and for business and administrative purposes the territory served is divided into twenty-six districts. Each district is in charge of a district manager who reports to the home office in San Francisco.

Work of the Sales Department

The sales department is one of nineteen departments constituting the home-office organization and has supervision, through the several district managers, of the salesmen who solicit new business and sell appliances, both gas and electric, except in the San Francisco and the Alameda County districts. In the places just named the company does not engage actively in the sale of appliances. It has, however, an independent force of solicitors, who are directly in charge of the district manager—and throughout both districts are well-stocked stores that sell appliances, which makes it unnecessary for the company to engage in the sale of such devices to the extent that appliance sales are required in its other districts.

Appliance displays are maintained in all the district offices and appliances are sold at a price which returns the company a fair margin of profit, it being the aim of the company to make its profits on appliance sales absorb to a considerable extent the expense of maintaining its sales organization. The policy of maintenance of prices will, it is believed, result ultimately in dealers engaging actively in the sale of appliances throughout the entire territory served by the company, so that the time will come when the company can, without injury to itself, discontinue the appliance business.

Co-operation with Contractors

For some time the company sold lamps for much less than the price at which the dealer could possibly compete. The company's purpose was not to get the business from the dealers, but to endeavor to control the lamp situation to the end that the consumer might receive lamps which were best adapted to his requirements. This seemed a proper function of the central station, nevertheless, it was found that the dealers would not look at it in that light and consequently they resented such activity.

About a year ago, therefore, after a conference with jobbers, dealers and contractors, this policy was changed and lamps are now sold at the regular retail selling price, with the result that the company's lamp sales have fallen off. However, the consumer is getting good service, owing to the fact that, as the result of raising the company's price, the dealer is able to compete on the basis of a good lamp, in place of a lamp which formerly he purchased solely on a dollar-and-cent basis.

Furthermore, this action by the company has con-

*Industrial engineer Pacific Gas & Electric Company, San Francisco, Cal.

FIG. 1—THE PACIFIC GAS & ELECTRIC OFFICE AT NAPA IS TYPICAL OF THE COMPANY'S DISTRICT HEADQUARTERS

verted the contractors and dealers into a great family of friends, rather than a number of individuals working inharmoniously.

The dealers, on their part, in order to co-operate with the company, some time ago started a campaign of wiring old houses, as a result of which one dealer alone wired almost 400 houses in a period of approximately four months. The revenue from this extension of service has been very profitable for the central station.

Salaries and Commissions for Salesmen

In districts having more than 1500 consumers one or more salesmen are employed on a straight salary basis and become a permanent part of the district organization, and these salesmen are required to canvass their territory thoroughly several times a year. Particular attention is given to new buildings, with a view to having special heating circuits installed, and suggestions are also made as to the best arrangement of lighting fixtures in order to secure the most satisfactory results. Districts having less than 1500 consumers receive attention from salesmen sent out from the home office from time to time.

The company does not engage directly in house wiring but does co-operate actively with wiring firms in the wiring of old houses, and this policy has resulted in the wiring of approximately 90 per cent of the houses on the company's lines. Special selling campaigns are held occasionally, and on such occasions a special sales force is assembled, the salesmen engaged working largely on a commission basis. These campaigns usually extend over a period of thirty days and have proved very satisfactory, almost invariably resulting in putting out a large number of appliances in a short time.

The sales policies are established by the home office, but are carried out through district managers, with the assistance of the sales department, as it is the company's policy to afford its managers every opportunity

FIG. 2—THE "PACIFIC SERVICE" SLOGAN IS A FEATURE OF EVERY BRANCH-OFFICE WINDOW

to prove their title to be managers in fact as well as in name.

The Evolution of Commercialism

The story of the evolution of business-getting methods in the territory of the Pacific Gas & Electric Company is an engaging one. Time was—twelve to fourteen years ago—when it required no effort to sell electric energy in California other than an assurance of continuity of service, and the sales department was merely an order-taking department, for the development of hydroelectric energy reduced tremendously the cost of power heretofore produced by coal as fuel for manu-

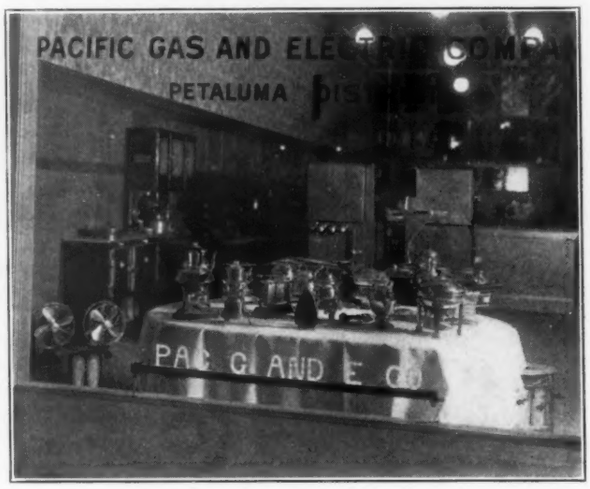


FIG. 3—AT THE PETALUMA OFFICE THE DEMONSTRATION TABLE SERVES ALSO AS THE WINDOW DISPLAY

facturing purposes. No one exclusive commodity, however, is ever permitted to go on unmolested and without competition, and oil was soon discovered in California and became the keen competitor of electric energy. A peculiar feature about the situation was, however, that, while oil was the hydroelectric plants' greatest rival, it was also the greatest boon in that oil-driven central-station plants were necessary as auxiliaries to the systems. Like all legitimate competition, however, it served only to stimulate the sale of central-station energy, and it was the cause of a sales department organization known as the commercial department in which men trained in the use of electric energy were employed and greater efforts were put forth to dispose of the supply.

The Organization Stage

A great deal has already been written about the hydroelectric development on the Pacific Coast—how pioneers in the field struggled to secure money for the development of sufficient energy to supply the market. They knew that there was a great demand for cheap power and kept their fingers on the pulse of the manufacturing world, knowing that capital was all that was required to build power plants and pole lines and secure good business.

The result was that different companies were organized and plants developed in various water locations among the Western Sierras. Power lines were stretched out, meeting each other and very often crossing into the territory of each other. There could be only one outcome, amalgamation, and thus the vast system of the Pacific Gas & Electric Company was the result of these several "knots," and a work of reorganization was undertaken which taxed to the utmost the greatest minds in the electrical business.

Here was a chaotic state of affairs. The electric distribution systems in some of the cities in the different territories were owned and operated by the pioneer hydroelectric company; others were owned by independent companies, and still others by individuals. These cities were in practically all cases acquired by the present parent company—a monumental piece of work—and districts formed, making the central city in each division

the district center with a district manager in charge who reported directly to the general manager. This division in territory necessitated taking from the old first-organized commercial department some of its territory. This latter department, however, retained a large amount of intervening territory, principally the

FIG. 4—THE MARYSVILLE OFFICE INVITES THE CUSTOMER'S PERSONAL ATTENTION TO THE APPLIANCES

mining and dredging lands, and the agricultural districts comprising reclamation, irrigation and general farm-motor-service business.

San Francisco district—typical of the basic system—maintains a contract department through which all business pertaining both to new business and renewals is transacted. Each member of the department not only solicits business but also acts as general agent for the company in the matter of complaints and other things which come up in his daily contact with the public. The city is divided into territories, one man to each, directly under a contract manager.

The Work of the Industrial Department

Another and very important department is the industrial department. This department was primarily established to create new uses for electric energy. It was apparent that there was business to be had which required not only a solicitation but practical demonstrations. Manufacturers were found using other methods of operation. These men had not given the proper attention to actual costs, but were just following old customs. In the department are employed experts who had studied steam conditions and who could make tests of steam plants complete. Being thus equipped with necessary instruments and knowledge, the entire steam plants of industrial manufactories are turned over to the industrial department for tests, some of them extending over weeks of time, with the result that many wastes are laid bare and many an obsolete steam plant is abandoned and electric motors operating from central-station power are substituted. The department very often comes to the aid of the contractor in helping to establish his apparatus in the construction of large pieces of work. Recently a large tunnel was constructed in San Francisco, and the contractor by taking the department into his confidence was not only able to save in the amount of machinery he purchased but also received aid and suggestions whereby he was able to cut his costs considerably. Owners of large reclamation districts of thousands of acres have placed their drainage and pumping problems in the hands of the department and have simply paid the bill for the apparatus when it became due, the department having made the drawings, ordered the machinery, superintended the erection of the plant, and passed upon the completion of it.

The Electric-Vehicle-Service System

The industrial department has recently worked out a plan whereby the electric company will be of very great assistance in the sale and utilization of electric trucks, in that it has established what is known as the battery-service system. While this system is in use in several cities in the United States, a short description of this new institution may be of interest.

An electric truck may be purchased now without the electric storage battery (an item of cost which has made the electric truck appear to have a high first cost). The sale being made under these conditions, the purchaser then enters into an agreement with the electric company whereby he is entitled to the battery-service system. This system provides that the electric company shall purchase and own the battery or batteries for the successful operation of the truck in whatever use it may be put to and at any time it may be necessary to operate, day or night. The agreement provides for the garaging of the truck, its oiling, washing and polishing, inspection for breakage, damages, etc. The agreement also provides that the electric company shall charge all batteries with electricity and keep them charged, so that all the driver of the truck will have to do is to call for his truck in the morning at the electric company's garage, drive away with a full battery and bring it back in the evening, forgetting it until morning; or, should he make a greater number of miles in a day than the battery is charged for, he simply drives back to the garage, and in a few minutes a new battery is inserted in the truck and he is away again. This may be done as often as he wishes, and it gives any truck the privilege of twenty-four hours' operation in busy times. In other words, it is just like going into the library and taking out a book—you take one out at a time as often as you may care to. The system of payment for the service rendered is rather unique in that it is made up on a two-rate charge. The merchant pays a flat sum in advance plus a rate per mile for the number of miles the truck has run during the month.

General Educational Work

One of the important features bearing on the policy of the company which the industrial department en-

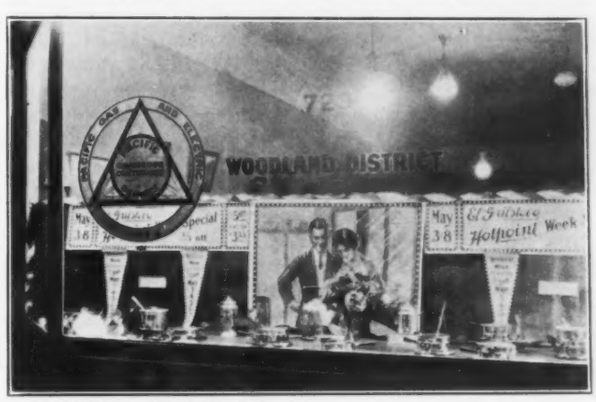


FIG. 5—ATTRACTIVE WINDOW DISPLAYS ARE AN IMPORTANT FACTOR IN APPLIANCE SALES AT WOODLAND, CAL.

deavors to fulfil is that it carries on an educational campaign, giving lectures and demonstrations both to other departments of the company and to its consumers.

It is the duty of this department to analyze the consumer's conditions and not only to advise the electric company as to the value of business but to make sug-

gestions to the consumer as to the best method of connecting up, which motors are most efficient, whether to connect directly or use belt drive, and to study the consumer's method of manufacture with a view to suggesting improvements in operation. This department also takes care of complaints of high bills, seeks to rearrange conditions whereby the cost of production may be reduced, and in every way places itself in the consumer's confidence as in a consulting capacity. It is remarkable how many cases come up in a day which demand expert advice—the changing of the location of a motor, the untwisting of a belt, the discarding of obsolete machinery, the rearranging of line shafting, and a great many other things.

In the department are also lighting experts who give advice as to illuminating buildings and stores. It is not an unusual thing for the electric company through the lighting experts to take upon itself the entire responsibility of the design for wiring and illuminating large buildings and stores, and thus, besides giving service, a great amount of business is secured. The services of the department are always in demand.

Selling Lamp-Socket Appliances

An Analysis of Eleven Years' Experience in Marketing Electric Household Devices in Southern California

By S. M. Kennedy*

Probably nowhere in the experience of the electrical industry has there been so extensive and long-sustained an observation of the performance of household lamp-socket appliances as in the territory of the Southern California Edison Company. Electric flatirons, toasters and percolators have now been actively sold in Los Angeles and vicinity for a period of eleven years, almost from the date of their earliest commercial practicability, and have passed through their various stages of mechanical and service evolution on a scale sufficient to afford deductions worthy of attention.

The selling methods and achievements of these years mark one of the most interesting developments in central-station commercial activity on the Pacific Coast, particularly valuable as the record of a consistent application of a settled policy of merchandising that has won its way by the pressing influence of good salesmanship. The record is free from the distorting effect of any recourse to spectacular—but often unprofitable—campaign methods that over-force a market to an unnatural degree and inevitably cause it to suffer shortly after in a temporary relapse. The popularity of the household applications of electricity has grown in Los Angeles gradually and healthfully.

The Impressive Figures

The dull times prevailing during the year 1914 very greatly affected the sale of electric-lamp socket appliances in southern California, but not in the same manner that the sales of other kinds of merchandise were influenced. Dull times and the necessity for economy only emphasized the utility of electricity for household purposes, and as a consequence more lamp-socket appliances were purchased in and around Los Angeles in 1914 than in any previous year. The Southern California Edison Company sold to its own customers during the year 1913 a total of 21,436 appliances using an average of 4.5 amp each, and during the dull year 1914 the company sold to its customers 27,081 similar appliances, an increase of 5645. That the promotion work done by the Edison company has stimulated the general demand in the territory covered is evidenced by the statement of one manufacturing concern to the effect that in the year 1914 it sold, in addition to its sales to the Edison company, approximately 28,000 electric appliances in southern California, and it is a well known fact that other manufacturers of these goods have also made large sales in the same territory during the same period.

The 27,081 sales made by the Edison company amounted to a total of $103,260.60, or an average of $3.81 for each appliance. With the exception of two or three special sales, all appliances were sold at manufacturer's list, and after allowing for all expenses in connection with these sales and the handling of such a large quantity of merchandise, there remained a balance of net profit which was considered entirely satisfactory. The great bulk of this number of appliances may be imagined when it is stated that if the quantity sold by the Edison company in 1914 were placed end to end in their original cartons they would extend a distance of over 4¼ miles. The Southern California Edison Company has received numerous inquiries as to how so many electrical appliances have been put into use upon its system, and perhaps the following information on this subject may be of interest to some central-station managers.

Conditions and Sales Methods

In the first place, southern California is a comparatively new country—that is, it has only recently been developed as compared with other territories—and consequently it is probable that there has not been so much difficulty in convincing the public regarding the advantages of electricity as in some older territories where there may have been more deep-rooted prejudices to overcome. A large percentage of the California public is looking for the easy way to get through the day's work, and the "easy way" is undoubtedly the electric way. In the next place, the company discovered at an early date the real value of the lamp-socket appliance load, and in 1904 began to develop this branch of the business. Every form of promotion work was utilized, with varying success. The advantages of appliances were advertised in newspapers, in circulars and in follow-up letters. The company sold appliances for a while at less than cost, put them out on trial, loaned many, and placed others on the instalment plan. Showrooms were maintained in the company's offices, and demonstrations were frequently given. All had their advantages in helping sales, but all were much too slow in building up a load. Eventually it was discovered that the only way to sell large quantities and do it quickly was to send expert salesmen to call on customers in their homes. This plan was commenced in 1907 and has been vigorously maintained ever since.

The company has a chief appliance salesman who directs the work of some fifteen assistants. About 80 per cent of the total sales are made through personal solicitation and the remaining 20 per cent in the company's offices. Salesmen are paid a small salary and

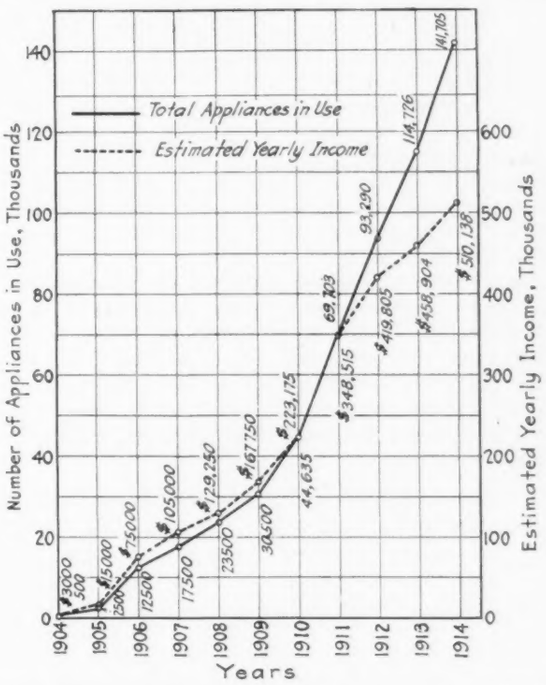
*General agent Southern California Edison Company, Los Angeles, Cal.

a good commission. About one-half the sales are made on the instalment plan. The terms are $1 cash at time of delivery and $1 per month with lighting bill until fully paid. Of the total appliance sales for 1914 ($103,-260), there were unpaid balances on the company's books at the end of the year amounting to a little over $14,000.

The Value of the Load

The value of lamp-socket appliances to an electric company is represented by their earning power. The figures that follow give the income per appliance derived by the Southern California Edison Company from household appliances in use on its system during the past eleven years: 1904, $6; 1905, $6; 1906, $6; 1907, $6; 1908, $5.50; 1909, $5.50; 1910, $5; 1911, $5; 1912, $4.50; 1913, $4; 1914, $3.60.

Of the total sales in 1910, 79 per cent were electric flatirons and 21 per cent other electric appliances. This condition has gradually changed year by year, and in 1914 the percentage of irons was 46 per cent and of



CURVES SHOWING TOTAL NUMBER OF APPLIANCES IN USE WITH ESTIMATED ANNUAL INCOME THEREFROM

other appliances 54 per cent of the total sales for the year. This indicates that the flatiron installations are nearing the saturation point, and that there is an increasing demand for household appliances other than irons. There are two reasons why the estimated annual income is gradually reduced, first, reductions in rates for service, and second, the fact that the increasing use of appliances other than irons tends to reduce the average monthly consumption per appliance. It is conceded that the iron is the best revenue producer of all lamp-socket appliances put on the market to date.

The accompanying chart shows the total number of appliances in use on the company's system each year from 1904 to 1914 with the estimated annual income derived therefrom. It will be noted that the curve showing appliances sold gives the totals in use each year, while the curve referring to income gives the estimated income for the year indicated. The total appliances sold by the company to its own customers up to Dec. 31, 1914, were 141,705, and the estimated gross revenue from the use of these appliances for the year 1914 was $510,138. In its calculations the company does not take into consideration the number of appliances sold to its customers by dealers and contractors, except to estimate that such sales more than offset the replacements of appliances worn out or in disuse from any other cause.

An Analysis of Service Conditions

In order to substantiate some theories in connection with its large connected load of appliances, the company recently sent to its district agents certain questions for their attention. The questions and the manner in which they were answered are given hereunder:

Question 1—(a) Are the dealers and merchants in your district selling electric appliances freely? and (b) do you consider that the amount of sales made by the dealers and merchants is equal to the amount of replacements in lamp-socket appliances required by customers in your district? The answers received to Question 1 indicated that 75 per cent of the districts (and these the most important ones) gave an affirmative response to the question as a whole.

Question 2—(a) What percentage of residence consumers in your district are using electric flatirons? and (b) what percentage of residence consumers are using one or more other lamp-socket appliances in their houses? The answer indicated (a) 90 per cent and (b) 50 per cent.

Question 3—(a) Are the consumers who have purchased lamp-socket appliances in your district regularly using these appliances? and (b) how or by what means do you know whether or not the appliances are being used? The answers were: (a) All agents replied "Yes." (b) "Through salesmen and deliverymen," "complaints when distribution circuits are 'killed' in daylight hours for necessary repairs." "Remarks of customers when paying bills," "complaints when voltage is low in daytime," "large number of repairs to appliances," "impatience of consumers when repairs to appliances are delayed," "charts showing load curves on residence circuits," "increases in individual consumption as shown by comparison of monthly bills before and after appliances have been installed."

Question 4—What is the estimated average annual income from each lamp-socket appliance which is installed and used by consumers in your district? The answers to this question indicated a variation from $2 to $9 per year, depending on the kind of appliance and the locality in which it is used. The replies indicated an average yearly income of $3.85 per appliance.

Each of the district agents who replied to the foregoing questions is in charge of a large territory and in comparatively close touch with his customers, and consequently the answers are based upon experience and constant observation. It will be noted that while the company desires to encourage the use of all kinds of energy-consuming devices, both big and little, it does not send out its salesmen to call on its customers to sell appliances of small consumption. There is as much labor in selling, billing and collecting on an appliance which uses 50 watts as on another using 500 watts. Consequently the labor is utilized to the best advantage, and only appliances using from 400 watts to 600 watts are sold by the company's salesmen on the outside. The appliances of small consumption are shown and sold in the offices and showrooms.

The Policy of Exchange

It is a difficult matter to determine just what is the average life of a flatiron, percolator or toaster even with the comprehensive data afforded by the wide experience of the Southern California Edison Company. Most of the older irons which were put out in Los An-

geles seven to ten years ago have been replaced by the newer types. These replacements, however, have not been necessary because the older irons have burned out or become inoperative, but in most cases because of their crude appearance compared with the newer models. The experience has been that a very small percentage even of the oldest electric irons have been discarded because they were not able still to do the work they were designed to do.

It has been a very rare occurrence for this company to be called upon to repair a toaster for any reason; but the percolator requires more attention than either the iron or the toaster, the reason for this being, of course, that sometimes the percolator is left in circuit when there is no liquid in the pot, and under these conditions the heating element not infrequently burns out.

Frequent Campaigns Round Up Old Appliances

The company's policy in exchanging or "cashing in" old appliances is very liberal. Once or twice each year a campaign is inaugurated for the purpose of acquiring, so far as possible, all the old flatirons and percolators from its customers and putting out in their place new electric appliances. The allowance made on old irons, whether sadirons, gas irons or electric irons, is 50 cents to 75 cents each, and by this means many thousands have been bought in and electric irons sold in their stead. However, it is to the credit of the earlier types that a very small portion of the irons so taken in have been electric irons.

In connection with the percolator campaigns of a similar character, the company has allowed $1 for every percolator or coffeepot turned in with the purchase of an electric percolator. These campaigns have also resulted in the putting out of several thousand additional electric percolators, the company taking in a corresponding number of old coffeepots, for which it allows the sum mentioned in each case. So far there have been no old types of electric percolators taken in exchange during these campaigns.

The Good Effect of "Bad Times"

During the period of financial stringency which is being felt in all parts of the country the incomes of many families have been restricted and expenses curtailed. As a result the electric flatiron has been more in use than ever, because more laundry work has been done at home. Many families now get along without help, and in consequence the electric percolator, the electric toaster, the electric chafing dish and electric grill have been purchased and used more freely, for by means of these the breakfast and often the lunch can be cooked on the table, thereby saving many steps to and from the kitchen. The more appliances in use, the more necessary is the electric company to its customers and the more opportunities the electric company has for making friends. The inevitable reduction in lighting rates and the increased use of tungsten lamps have both tended to reduce the amount of income for lighting service from all classes of customers, but the lamp-socket appliance points the way permanently to build up the income from residence consumers and at the same time help to improve the load-factor materially. The building of an appliance load is the real intensive development for the central station to work upon assiduously. It means an increased income, an added day load, a better load-factor—all at no additional cost to the central station—for the generating equipment, distributing lines, transformers, services and meters are already in and rarely require to be increased or reinforced on account of the installation of lamp-socket appliances. And the profit on the appliances sold to consumers pays all the costs of making the sales.

SELLING IN THE IRRIGATION COUNTRY

The Scope for Central-Station Sales in the Varied Territory of the Pacific Power & Light Company

No more interesting stories have ever been told by central-station men than those which come from the pioneer districts of the Far West, in the regions where electricity is being harnessed to the work of the irrigation farmer. The problems which have beset the commercial pioneers to whom the development of this new market for energy has been intrusted have called for an unusual versatility.

To sell electric motors for a service which is yet novel to the experience of the local farmers has demanded not only engineering skill and salesmanship of a high order but a groundwork of agricultural knowledge exceedingly difficult to obtain. But it is safe to say that the conquest of this new and almost limitless market has come more through the practical study of farming by the central-station men than by any other single influence. Progress has been won through the education of the people, and in every case the first necessity has been to secure the confidence of the farmer and to qualify as being competent to advise him in matters affecting his own work.

The experiences of central-station development in almost all sections of the irrigation country have been generally dissimilar, and the story of the evolution of the irrigation load in Pasco, Wash., serves well to paint the picture.

The Pasco Territory

The Pasco branch of the Pacific Power & Light Company embraces an intensely interesting territory, unusual and extraordinary in many respects. Let the reader imagine, if he will, a long stretch of territory 125 miles in extent, bounded on the north by the Beverly Gap, through which the mighty Columbia flows, and on the south by the Wallula Gap, with the valley in between sloping gently on both sides to the river and containing thousands of acres of fertile land, each acre of which requires electric power to bring it under cultivation. As long as twenty years ago irrigation by gravity was practised in this valley on a fairly large scale, but owing to the inexperience of the operators and the fact that the promoters had no idea of the actual cost of irrigation, practically every one, without exception, eventually went into bankruptcy. Notwithstanding all setbacks and discouragements, however, the valley continued to build up and progress, and with the advent of the Pacific Power & Light Company in 1910 and 1911 wonderful opportunities were presented.

The Early Situation

To give an idea briefly as to the situation that confronted this company at the start, let it be understood that in this valley there is a prospective acreage awaiting cultivation of nearly 250,000,000 acres, requiring possibly 75,000 hp or 100,000 hp. Practically all of this land is under a 100-ft. lift, the biggest part of it is less than 50 ft., and the water is available in wells and in the Columbia River in sufficient quantities to irrigate ten times that amount of land; so the one thing necessary and lacking was a dependable and reasonable source of power to do the necessary work in putting the water on the land. The start in the irrigation power field was made in a very small way, however, as the officials of the company were new to the field and wanted to make as few mistakes as possible. Therefore a single community was first taken up and thoroughly canvassed for "power" contracts.

At first the idea took readily, and a sufficient number of customers was obtained to warrant giving them a good deal of attention and helping them work out their

problems as they went along. The troubles that developed were by no means small in number, as inefficient pumping units had been purchased, outfits too large and too small were installed, the farmers, most of them city-bred, understood little of irrigation, and for a year or two conditions were chaotic and the cost per acre for power was too high. But, with a wisdom shown to be almost prophetic, the company held to its straight and narrow course of solving the problems arising in this one little community, and at the end of two years the seemingly unsurmountable difficulties had vanished. The other districts in the valley were then canvassed, and the business came in leaps and bounds and has grown to the present day to about 3500 hp in this particular class. In making the new extensions the company had figured on a possible revenue of $25 per hp-year, and although three years ago the income had not reached this figure, to-day it has grown to an average of $28.

The company now feels that it has attained a firm foundation and is about to make its start in earnest for the 75,000-hp or 100,000-hp goal.

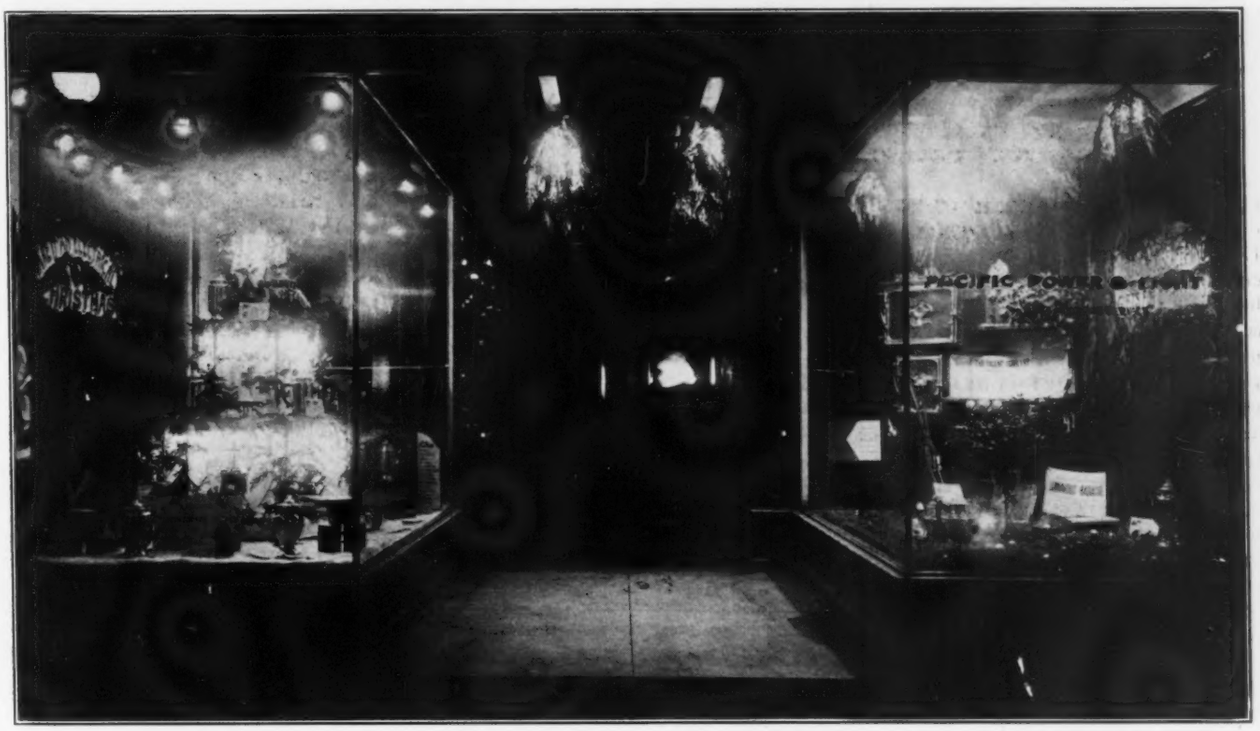


FIG. 1—A PRIZE-WINNING WINDOW DISPLAY THAT EXHIBITED EIGHTEEN VARIETIES OF ELECTRIC HOUSEHOLD APPLIANCES TO THE PEOPLE OF PASCO, WASH.

Qualifications of the Salesman

Mr. G. D. Longmuir, local manager of the Pasco branch of the Pacific Power & Light Company, under whose direction the work has progressed so successfully, gives the following account of the selling methods which have been applied:

"A central-station commercial man's qualifications for this particular territory are varied and exacting," he says. "First, he must be thoroughly familiar with all prime movers, electric, steam, oil, gasoline, distillate, water-power and hydraulics, as well as pumps, pipe lines, methods of irrigation distribution, duty of water and all apparatus used in connection with irrigation and power machinery. He should further have considerable knowledge of soil and its characteristics, climatic conditions as they affect the farmer and his use of water, fertility of soils, diversification of crops, preparation of the lands, and kinds of crops. In addition to this, he must be able to answer all kinds of technical questions, as many times he will be called upon to do so in the field, and upon his answer may depend the securing of the contract. He should be of engaging personality, diplomatic and tactful, and in his dealing with the farmer should establish confidence between him and his company. Added to all these, he must have all the general qualifications required of a city commercial man.

"I still remember what a thrill of satisfaction it once gave me to tell a farmer of twenty years' experience that he should cut his first crop of alfalfa at a time when the roots of the second growth had reached a certain height, instead of waiting for the plant to blossom, as the farmers generally did. Many times by waiting for the blossom to arrive the second growth had reached such a height that the first and second crops were cut at the same time, and the second growth was thereby stunted. From kilowatt-hours to the market price of beef cattle or hogs is a long jump, but the successful commercial man in this district has got to make it."

In population, the Pasco district figures are very small, there being probably not more than 8000 or 9000 people in the whole valley, but this includes several progressive little cities with lighted streets that would do credit to an Eastern city ten times the size and with motor and lighting loads of a size that are usually only found in large cities.

"We have our selling campaigns," Mr. Longmuir continues, "and have introduced every known appliance; and as for flatirons, it is like looking for a needle in the haystack to find a customer without one. Electric ranges are just getting started, but we already have twelve of them in use, and their operation is so satisfactory that the customers cannot get along without them. We are now working on a hot-water heater for use in connection with ranges and have practically decided on arrangements that will put one of these into every house that uses a range, and we believe that this one feature will remove the greatest obstacle we have

had in the way of selling ranges. We have at various times featured house-wiring campaigns wherein we had the wiring done for the customer on a flat contract from the contractor, the company assuming the bill and allowing the customer to pay for it in ten monthly instal-

FIG. 2—THESE HOGS WERE FATTENED FROM ALFALFA IRRIGATED BY ELECTRIC PUMPS

ments. We have disposed of hundreds of flatirons by offering, for one or two weeks only, an ironing board free with every purchase. One of the most successful campaigns we have ever had was instituted last December. In this some twenty branches of the Pacific Power & Light Company competed for a twenty-five-dollar prize. We were to be judged 50 per cent on the selling value and attractiveness of our window displays and 50 per cent on the gross sales in dollars and cents of appliances per customer served. We captured this prize. Our windows were appropriately trimmed Dec. 1, our newspaper advertisements began at the same time, and with our November bills mailed out Dec. 1 went a personal letter to 1500 husbands, our one aim and idea being to drive forcibly home to each of them the suggestion of a suitable and useful Christmas gift for his wife. We averaged nearly 50 cents per customer in appliance sales and cleared $200 profit on them for the company. All appliances were sold at list prices.

The Local Organization

"Owing to the greatly scattered condition of the territory under the Pasco office, it is necessary that we have men in the various small towns who are capable of doing line work, adjusting complaints, reading meters and making necessary collections; and we have been fortunate in securing men for these positions who are tactful, diplomatic and ambitious. Theoretically and practically, as much as possible, the local manager is the salesman or commercial man, for by arranging his various duties so that subordinates may take care of the routine work he is enabled to devote the greater part of his time to the solicitation of new business. For my part, I aim to keep in touch constantly with all of the men at the various sub-offices, and every man and woman in the employ of the Pasco office is on the alert for the sale of the various appliances or the closing of contracts. The larger contracts are handled by the local manager, and when he needs help he is able to secure it from Portland, the general office of the company.

"Our plans so far have never called for house-to-house canvassing, on account of the expense involved and also for the reason that the great majority of our customers call at the offices to pay their bills, and any new scheme we have for the furtherance of new business is brought to their attention by the cashiers when they are paying their bills. In this manner, with constant pegging away and being on the job for twelve months in the year, we have met with surprisingly great success, and the percentage of saturation on appliances is high."

Astoria—Another Picture

From Astoria, Ore., another district of the Pacific Power & Light Company's territory, comes a very different story, which is best given in the words of Mr. J. B. Rilmore, the local manager at this little riverside city. Astoria presents, not an irrigation market, but the usual problems of business development in a settled community, a lumbering and fishing center with a mixed population, mainly Finnish, Swedish and Norwegian—thrifty people, most of whom own their own homes. Mr. Rilmore writes:

"Our principal commercial effort for the past fall and winter has been directed to securing the wiring of old houses, offering as an inducement to pay for the wiring of the house, including the fixtures, and permitting the consumer to pay us back in monthly instalments. As a further inducement, the wiring contractor doing the work gave a flatiron with every house he wired. This worked out fairly well, but after the first few payments the majority of the new consumers paid in full rather than carry out their instalment agreement. After a few months with the instalment proposition we discontinued the offer and went after the business on a straight cash basis, or, in other words, left the business with the wiring contractors.

"After turning over the business to the contractors we showed them the necessity of getting out after the business and succeeded in arousing them to enthusiasm to such an extent that they have each placed a man outside to go after it.

"During the past four months we have wired 187 old houses, and nearly all of them have been houses belonging to fishermen and the men in the mills. It was rather hard work at first to interest the Finnish people in using electric light, but by getting several of their houses wired and connected up and using several of their own people to help us we have added nearly all of their houses to our lines.

The Selling of Appliances

"We have been successful with appliance sales through co-operation with the wiring contractors and hardware

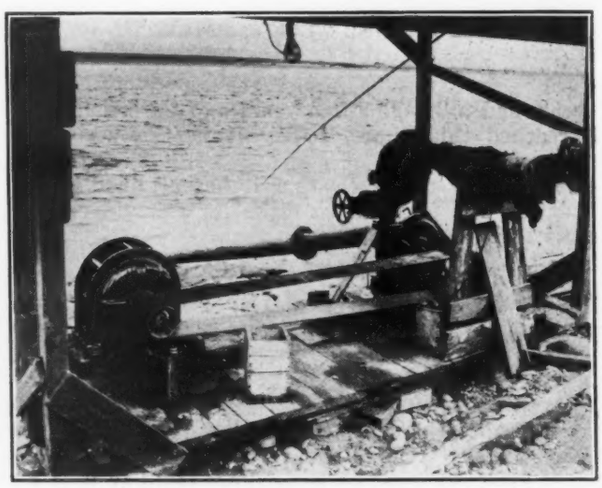


FIG. 3—A 20-HP OUTFIT IRRIGATING 80 ACRES AND REPLACING A GASOLINE ENGINE THAT BROKE DOWN

stores. At one time the company sold everything electrical that was sold in the town, and all appliances as well as lamps were sold below the cost price. During the last few years we have sold all lamps and appliances at the regular list prices, and we have gone to the dealers

and induced them to put in stocks of lamps and different appliances, with the result that we now have five places where appliances are advertised and sold, and the appliance sales are five times what they were when the company cut prices. One contractor is now pushing an iron campaign and making a house-to-house canvass. Notwithstanding that 314 irons were sold during the past year, fifty irons have been placed during the last few days, and as yet less than half of the town has been covered. During the past year 233 appliances other than irons were sold in the town, and we feel that had the company been the only selling agent not more than one-fifth of the above amount would have been sold. The different dealers have also been active in placing the new gas-filled lamps, and a great number have been sold since they have come on the market. At different times we have our new-business man go out along with the contractor's man and inject new enthusiasm, taking up different lines of opportunity, which gives us greater activity and keeps the game moving.

Light and Motor Business

"During the past winter we have been active in getting the merchants together and lighting up the principal streets of the town and have made a fair showing. As the town is built over the river and the streets and sidewalks are built out of lumber, which requires renewing frequently, it is impracticable to install a post system of lighting, and we therefore have substituted the regular magnetite lamps strung across the street, and we now have forty-three lamps, which are paid for privately by the merchants fronting on the street. An active sign campaign was carried on during the winter months, and fourteen signs were sold on a five-year instalment basis, making us about forty electric signs, which burn from dusk until midnight on a flat-rate basis. We have also got the wiring contractors into the motor game by giving them all the help they need and showing them how to work up propositions, so that instead of having only one active agent, ourselves, we have several.

"We do a fair amount of advertising, featuring the articles upon which we are working at the particular time, and we also avail ourselves of all the advertised matter which comes to our office. We keep good active windows and have induced the other dealers to use their

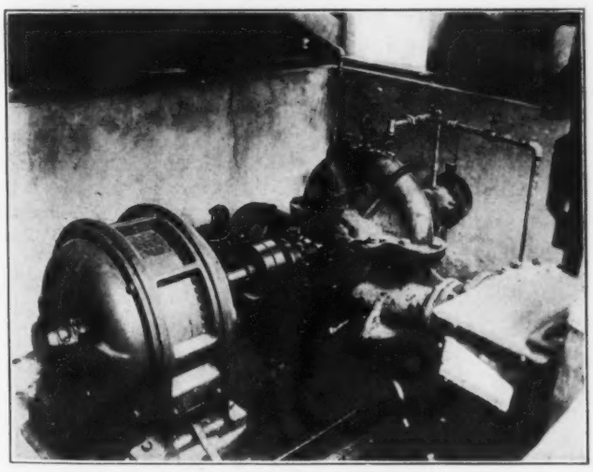


FIG. 4—THIS 25-HP MOTOR IRRIGATES 160 ACRES OF ORCHARD AND ALFALFA LAND NEAR PASCO IN THE COLUMBIA RIVER VALLEY

windows more for electric displays, which helps not only in selling the appliances but the general business as well. During the holidays we have taken full-page 'ads' and combined the names of all the other dealers with ours and have materially increased the sales. We have found that by close co-operation and exchange of ideas with the different dealers and wiring concerns we have not only got more out of our new-business department and increased our business materially but have also

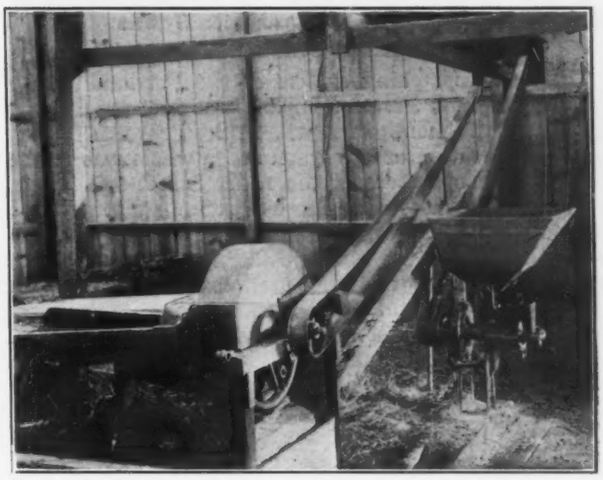


FIG. 5—A 2-HP MOTOR THAT OPERATES THE FARMER'S FEED CUTTER, CREAM SEPARATOR, GRINDSTONE AND A DOMESTIC PUMP

helped to keep the wiring contractors from 'getting stale' and possibly going out of business.

"Astoria has a population of 10,000, of which the majority are foreign-born. Our present connected motor load is 2325 hp; we carry city contracts for 140 magnetite-arc lamps, and we have a total connected load of 4025 kw, none of which is for irrigation, since the total yearly rainfall here is close to 80 in."

Other Glimpses of the Section

Throughout all the widespread territory of the Pacific Power & Light Company the work goes on, with conditions ranging all the way from the agricultural to those strictly urban in character.

The little town of Mosier, Ore., with only 100 inhabitants, situated on the Columbia River 16 miles below The Dalles, now has nearly thirty 100-watt street lamps —one on practically every corner—as the result of hammering the advertising feature into the local public at the time it was congratulating itself upon the decision of the State highway engineers in routing the Columbia River Highway through the enterprising little town.

In the case of every building of any size which has been erected in The Dalles during the past few years the company has been successful in securing the installation of motors for construction purposes, such as the driving of concrete mixers, elevators, saws, etc. The local manager also makes it a point to keep track of all idle motors. This practice in several cases has enabled him to put the contractor in touch with machines that could be rented locally.

Sign campaigns have been pushed energetically in the towns and villages. Country fairs have been utilized for the demonstration of irrigation equipment and household appliances. In short, this big open country of the West, in addition to its own peculiar problems of agricultural co-operation, has followed closely all developments in the art of central-station merchandising and has applied them most effectively. The spirit of the West is inherently progressive and the market has responded promptly and to a degree that is astonishing to those who have not been in personal contact with the work.

POWER AND OPERATING SECTION

THE WORK OF THE LOAD DISPATCHER

Duties and Routine of the Man at the "Nerve Center" of the Portland (Ore.) Transmission System

BY R. R. ROBLEY, OPERATING ENGINEER

The load-dispatching system of the Portland (Ore.) Railway, Light & Power Company was first put in commission in the month of April, 1912. Previous to that time the operation of the system as a whole was in the hands of the operators at the Alder Street substation, the oldest and most centrally located substation on the system. While the system was growing from the one generating plant and one substation of twenty years ago to the three hydroelectric stations, five steam plants and ten substations of sixteen years later this arrangement was very satisfactory, but with the completion of another hydroelectric station and another steam plant and with the doubling of the equipment of the Alder Street substation it was felt that greater efficiency could be secured by separating the system operation altogether from any other branch of the work. Accordingly a room on the sixth floor of the Electric Building near the general offices of the light and power department was equipped with the necessary maps and instruments for the new work, and the operation of the system as a whole was turned over to load dispatchers, of whom there are three, each on duty for eight hours daily.

Qualifications for Load-Dispatching Work

The three men chosen for this work were experienced operators in the employ of the company. They were clear-minded, cool and level-headed, and above all they had the entire respect and confidence of all the other operators who must report to them. These same three men are still in charge of this office, reporting directly to the operating engineer, and their choice has never been regretted. The chief dispatcher has a regular shift from 4 p.m. to midnight. The other two men have shifts from midnight to 8 a.m. and from 8 a.m. to 4 p.m. and change every month.

The room selected for the dispatching office is directly over the Alder Street substation, the substation occupying a portion of the first floor and the basement of the Electric Building. The entrance to the office is through the office of the operating engineer.

An L-shaped desk, a table and a swivel chair, with an occasional chair for company, is the extent of the furniture in the room. Directly in front of the dispatcher's desk is a telephone cabinet connecting to all city stations, and next to this is a voltmeter plug board. On the wall above the desk is a Western Union clock and an instrument board. On the short end of the desk is a telephone cabinet connecting to all distant plants, and directly above this a disk board to indicate the apparatus that is in service. Across the end of the room is a board map of the high-tension system, while on the rear wall there is a bulletin board.

Telephone Connections Cover System

The telephone board in use for the city stations is a standard Kellogg unit with five talking buses, with provision for twenty two-party lines. Ringing is done with a two-way key so that operators are not required to distinguish code ringing. The board at the present time gives connection to nine substations, three steam plants, to the train dispatcher of the Oregon Electric Railway Company, to three light and power department offices, and to the Home Telephone exchange in the Electric Building. The board and all lines serving it are rented from the Home Telephone & Telegraph Company at regular tariff rates.

The telephone board to serve the distant plants is of the cord type of the ten-line size, equipped for either magneto or pole-changer ringing. The board has connections for six lines to the different hydraulic plants, the other four positions being used for various local

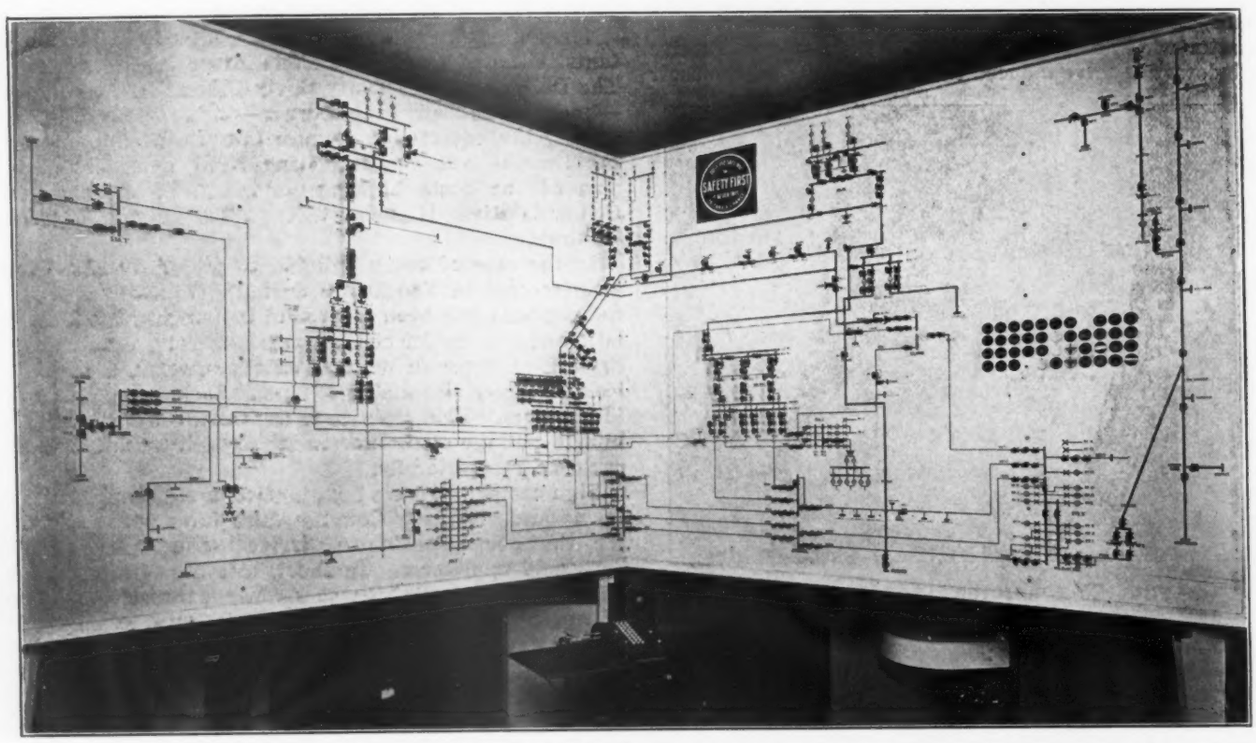


FIG. 1—WALL DIAGRAM OF THE PORTLAND COMPANY'S HIGH-TENSION CIRCUITS IN THE LOAD DISPATCHER'S OFFICE

company lines. Any line on this board can be connected to the regular Home Telephone system through a repeating coil.

All telephone lines paralleling high-tension lines are thoroughly protected by insulating transformers, heat coils and fuses. The office is also equipped with a main line Home Telephone instrument and a main line and a local Pacific States telephone. Pacific States telephones are also installed in several of the city stations and substations so that, with two distinct city systems in addition to the company's private lines, there is only a remote possibility of total telephone interruption between the dispatcher's office and any station even in the most severe case of trouble.

A glance at the instrument board will reveal quite a number of pilot lamps and several instruments. The pilot lamps at the top of the board are connected to the secondary circuit of transformers inserted between the oil switch and the line side disconnecting switch on each of the six 11,000-volt, thirty-three-cycle lines and the three 11,000-volt, sixty-cycle lines feeding energy into Alder substation. A voltmeter and a frequency indicator are provided for each system, the two horizontal instruments on the left being for thirty-three-cycle and those on the right for sixty-cycle service. Over the back corner of the desk are two Westinghouse recording meters, a voltmeter and a frequency meter connected in multiple with the sixty-cycle indicating instruments directly over them. A plug receptacle is mounted on the plug board for the secondary from each high-tension feeder so that the instruments can be plugged in on any incoming line as desired. This feature is especially valuable in case of serious trouble on the system. The astatic instrument at the left is a 750-volt voltmeter which can be plugged on either the 600-volt railway bus or the 600-volt commercial bus. Pilot lamps connected to each bus show dark only when the bus is dead. The astatic instrument at the right is a 300-volt voltmeter which can be plugged on either the low, main or high-voltage direct-current underground bus. Pilot lamps are also installed on these buses.

The board map shown in Fig. 1 is made up of soft cedar. It is approximately 6 ft. by 15 ft. in size. On it are shown all stations, substations, high-tension lines and all switches that control the high-tension circuits.

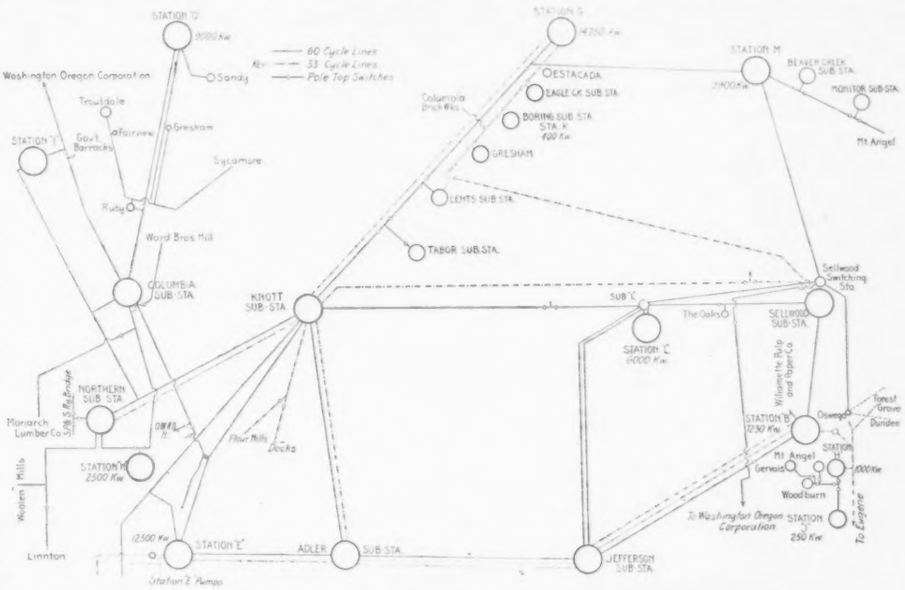


FIG. 3—SINGLE-LINE DIAGRAM OF PORTLAND COMPANY'S SYSTEM

The map is a single-line diagram, the thirty-three-cycle system being shown by green lines and the sixty-cycle system by red lines on a dull white background. An oil switch is indicated by a circle, a disconnecting switch by a cross, and a pole-top switch by a cross within a circle. Pole-top switches are numbered on the map, and the switches themselves on the poles bear the same number so placed that it can be seen plainly by anyone attempting to operate the switch. Oil and disconnecting switches are not named on the map, but all are plainly marked in each station, and blueprint maps of the station wiring in the dispatcher's office bear the same marks.

In holes bored and reamed in the center of each switch indicated on the map ordinary violin plugs are inserted to indicate the position of the switch, the plug being pulled out when the switch is opened and inserted again when the switch is closed. No substation apparatus other than high-tension transformers are shown on the map. Near the right-hand edge of the map will be noticed several dark round spots. These are red poker chips, each chip bearing the name of a lineman or repair man. Their use will be explained below.

FIG. 2—LOAD DISPATCHER'S DESKS AND INSTRUMENTS

The disk board over the small telephone board in Fig. 2 is about 24 in. spare and 1 in. thick and is painted white, with the names of all stations and substations shown along the left-hand edge. Following the name of each station is hung a white poker chip for each machine in the station. The chip is painted blue on one side, and each side bears the name and number of the particular machine. When the white side is turned out the machine is understood to be running; when the blue side is turned out the machine is shut down but ready to run. When the chip is removed from the board a red circle bearing the same name and number is shown to indicate that the unit is out of commission.

Many blueprint maps and charts are kept constantly on file and up to date in the office, so that the dispatcher has at hand all information needed regarding all phases of system operation. Among the principal maps might

be mentioned complete wiring diagrams of each station and substation, maps of all high-tension lines, maps to scale of all the city feeders (including arc circuits, 2300-volt alternating-current feeders, 600-volt direct-current feeders, both railway and commercial, and 240-volt direct-current feeders), curves showing the flow of water from elevation readings of rivers furnishing water-power, and charts showing the storage capacity of forebays at various elevations expressed in kilowatt-hours. There is also a map of the 240-volt direct-current underground system showing all the feeders and mains, all junction boxes and fuse boxes and manholes. A complete map of the 600-volt trolley and overhead-feeder system in the underground district is on file, showing by different colors the trolleys and feeders that serve any particular district. This map is of especial importance in that the city fire chief or one of his assistants may call at any time to have all 600-volt service rendered "dead" within certain limits.

A.M.	11-23-14
9:40	Told Dawson, E. Dept. to make arrangements for a 15 min. shutdown on 2300 V. fdrs out of Sell. Sub. acc't will kill 60 cy. bus to reconnect leads to oil sw. on line #11671 during noon hour today. Rep. above done & O.K. bet 12:05 & 20 P.M. at 10:45. Notified H.E.Wagner at 9:45.
:40	Keith. Sta. G. cut in #5 exciter. :45 #4 Gen.
:52	Smith Sta M. cut out #2 Gen & tagged for F.G.Robley to work on governor pump, acc't same looses pressure once in awhile. O.K.ed :50
:58	Bates Gresham, cut out #1 Rotary
10:03	Gave Schmidt, Sta. L. permission to have #2 Gen. out of com. to work on connection to dry vacuum pump. Request of W.I.Barley at 8:20
:55	Smith, Sta M. rep. F.Robley clear of #2 Gen & same in com. Adjusted valves of governor pump.
11:00	Smith, Sta. M. cut in #2 Gen.
:13	Keith, Sta G. cut out #3 Gen. :17 #5 exciter.
:53	G. New asked permission to work on line #11671 at Parkplace Has 7 poles to replace O.K.ed. Told him line was dead & tagged for H.R.Wakeman, that I would tag line for him right away & for him to ground line if he wanted to. Said he would ground line.
:57	Mariole, Sell. tagged line #11671 for G. New.
:58	Hannaford, Sta. B. tagged line #11671 for G. New.
P.M.	
12:05	Mariole, Sell. cut out 60cy. 11000/2300 V Trans. line disc. sw's line #11691 & tagged for H.E.Wagner
:06	U.Wash - Ry. Feeder out and in, Alder, Bruce.
:06	" " " " " " " Sta. B. Dimmer.
:11	Told Dawson E. Dept. 12:00 arc ckts tested O.K.
:17	H.E.Wagner rep. clear of oil sw. on line #11671. Bus leads connected to same.
:18	Mariole, Sell. cut in line #11691 & 60 cy. Trans.
:05-:16	Sellwood & Milwaukie 2300 V 60 cy. fdrs dead, Sell. Mariole
:21	Mariole, Sell. removed H.E.Wagner tag from line #11671 O.K.
:44	Carr, Knott rep. cleared grd on operating bus. Found same on line #11610 alarm. Rep. above gr'd at 9:20
1:07	Kasdorff, Line Dept. rep. will want line #11671 all day to-morrow for G. New ro replace 7 poles. C. P. Osborne said they had to be clear of line by to-morrow night.
1:42	Mariole, Sell. rep. pump O.K. & tank full
:44 - 47	" " cut in 33 cy. Trans. L & H.T.Side
:56	Barley Sta. L. rep. #2 Gen. in com. 1:45
2:05	Dimmer, Sta. E. cut in #1 Rotary & out #4 M.G. Set.
:50	Called H.R.Wakeman & requested that he rep. clear of line #11671 as same was still tagged for him. Said he was clear of line & that his tags could be removed.
:54	Bruce Alder cut in #5 MG.Set M.R.
:55	Mariole, Sell. removed H.R.Wakeman's tag from line #11671
:56	Hannaford Sta. B. removed H.R.Wakeman's tag from line #11671
3:35	Told Howry, E. Dept. 3:30 arc Ckts. tested O.K.
Foster	
4:00	Barley Sta. L. cut in #1 gen on Jeff. tie line.
:05	Crombie Sta. E. cut in # 4 M.G.
:06	James Sta. G. cut in #3 Gen.
:28	G. New reported clear of line #11671, wants it tomorrow

FIG. 4—TYPEWRITTEN COPY OF PAGE OF LOAD DISPATCHER'S LOG BOOK

While it is the primary duty of the load dispatcher to take care of the system operation, there are certain records that must be kept in order intelligently to do so, and these he puts into permanent form for later reference in his own office or by other departments. The daily log book is perhaps the most important record that he keeps. It is a record of everything that takes place so far as the operation of the system is concerned. As each dispatcher comes on shift he is required to read all entries made in the book since his last shift.

The daily load sheet—another important record—is made up hour by hour as the operators from the generating plants telephone in the generating record for the hour previous. Fig. 5 shows a completed sheet. Curve No. 1 at the bottom of the sheet shows the 600-volt direct-current output. Curve No. 2 shows the total steam station output, Curve No. 3 shows thirty-three-cycle output, while Curve No. 4 shows sixty-cycle output. Curve No. 5, which shows the total generation of the Portland system, is equal to curves No. 1, No. 3 and No. 4 superimposed one upon the other. Curve No. 6 shows the output of the Upper Willamette Valley system and is superimposed on curve No. 5. Other information shown on this sheet is the total output for the day at each station, peak demands, load-factors, etc.

Substation operators are not required to make regular reports to the dispatchers, but they report each hour from stations where only one man is employed on a shift.

The general rule is that generating units shall not be placed in service or removed without orders from the dispatcher, except in cases of emergency, when the operator uses his own judgment. Interruption to service is permitted only as a last resort.

Substation units employed at regular intervals are cut in and out without orders, but this is reported as soon as done. The high-tension line switches are never opened or closed without direct orders from the dispatcher.

The Dispatcher's Word Is Law

In case of trouble on the system the dispatcher's orders are law without question. Operators first restore the interrupted service if possible and then report to the dispatcher and await his orders. Emergency lineman and station repair men are always at his command and take orders directly from him. If necessary, he can call out the whole repair department, though this is generally done through the general foremen.

The matter of shutting down high-tension lines for repairs, and the safeguarding of the men who must work on them, has received most careful attention. A regular form for "high-tension-line shut-down" is filled out by the general line foreman, giving the number of the line that is to be "killed," the name of the lineman who will work on the line, and the time, the place and the nature of the work to be done. After the order has been approved by the operating engineer, who also assigns a number to it, the original is given to the load dispatcher and a carbon copy is given to each lineman who is to report on the line. The number given to the order is not in the nature of a serial number, but is selected arbitrarily to be used as identification for the lineman when he reports the line ready for service.

Both Oil Switch and Air-Break Switch Are Opened

A line foreman ordinarily asks that the line be "killed" about thirty minutes before he actually needs it to allow for time to shift the load. After the first call for the line the dispatcher orders the oil switch and at least one set of air disconnecting switches to be opened in each station controlling the line. On receiving the switching order the operator writes it down on a printed form and then repeats the order for an "O.K." After the order has been executed it is again repeated to the dispatcher as completed, and the dispatcher at once pulls the corresponding plugs on the board map to show that the line is open again at that point. As soon as a line is opened for anybody to work on it the main switch controlling this line is tagged by securely tying to the handle of the switch a red card about the size of an ordinary shipping tag showing a man at work on the line. Any operator who closes a switch bearing a red tag is subject to instant dismissal without further question.

When a lineman asks for a line a second time his request is repeated back by dispatcher for the lineman's "O.K.," and his request and "O.K." are noted by each party on his "shut-down" orders. The lineman is informed that the line is "dead" and is told whether or not it is grounded at the station. The dispatcher at

once hangs on the board map a red chip bearing the particular lineman's name over the line cut-out. In case the line is to be grounded a white chip bearing the usual ground connection symbol is hung beside it. If more than one lineman reports on the line, a separate tag for each man is placed on the switch and a separate red chip on the board map, and the line cannot be returned to service until all tags have been taken off. When the lineman reports the line clear the dispatcher repeats the report back for an "O. K.," and both parties make note of it on their "shut-down" orders. The lineman is asked for the number of his "shut-down" order. If this corresponds to that on the dispatcher's order, the man who called for the line is considered to have identified himself, and he is told that the line will be placed in service at once. The dispatcher removes the red chip from the board, orders the switch tag removed at the station, and, in case no other tags are in the switch, orders the line returned to service, the same repeating of orders being carried out in this as when the line was "killed." The original switching order as taken by the operator and the switch tag are sent to the operating engineer's office.

All high-tension lines are given numbers which show at a glance the voltage and the frequency of the line and the stations from which they transmit energy. Consider, for example, line No. 11,672. The first two figures on the left indicate 11,000 volts, the next figure indicates sixty cycles, and the last two the individual line number. In like manner, 11,324 would indicate 11,000 volts, thirty-three cycles, and 57,602 would indicate 57,000 volts, sixty cycles. On two lines which can be switched to operate at either thirty-three cycles or sixty cycles, the frequency is indicated by the figure 4; thus, 11,405.

Railway feeders, 240-volt feeders and 2300-volt feeders are not numbered but are named according to the communities served by them.

The foregoing gives a good idea of the working of the load-dispatching system and of the duties of the dispatchers themselves, but it should not be assumed therefrom that all of the work in this connection is routine. The dispatchers necessarily do considerable record work, but the real value of the whole system is attributable to the fact that there is some one who is always making a study of the conditions of the system and he is in a position to decide immediately and definitely as to what method of operation to pursue no matter what problem may come up. Especially is this true during the season of low water at the hydroelectric plants where the steam equipment must be used to supplement the water. At this time several troublesome factors appear—the demand on the thirty-three-cycle system and on the sixty-cycle system, with the steam and water generating equipments for the corresponding systems, the water storage and demands at the various hydroelectric plants, the available supply of saw-mill refuse for steam-plant fuel and the ever-present dread of being forced to burn fuel oil. The dispatcher can imagine only one thing worse than having to burn fuel oil, and that is interruption of service.

In summing up, the benefits derived from the installation of the system are noticeable in the more equal distribution of the load between the generating stations, thus preventing undue overloading of the tie lines, with the consequent loss due to such overloading; in the studied handling of the wattless current of the system, and generally in the more efficient operation of the system as a whole. Last, but not least, when serious and unavoidable trouble does occur the service is restored with the least possible delay.

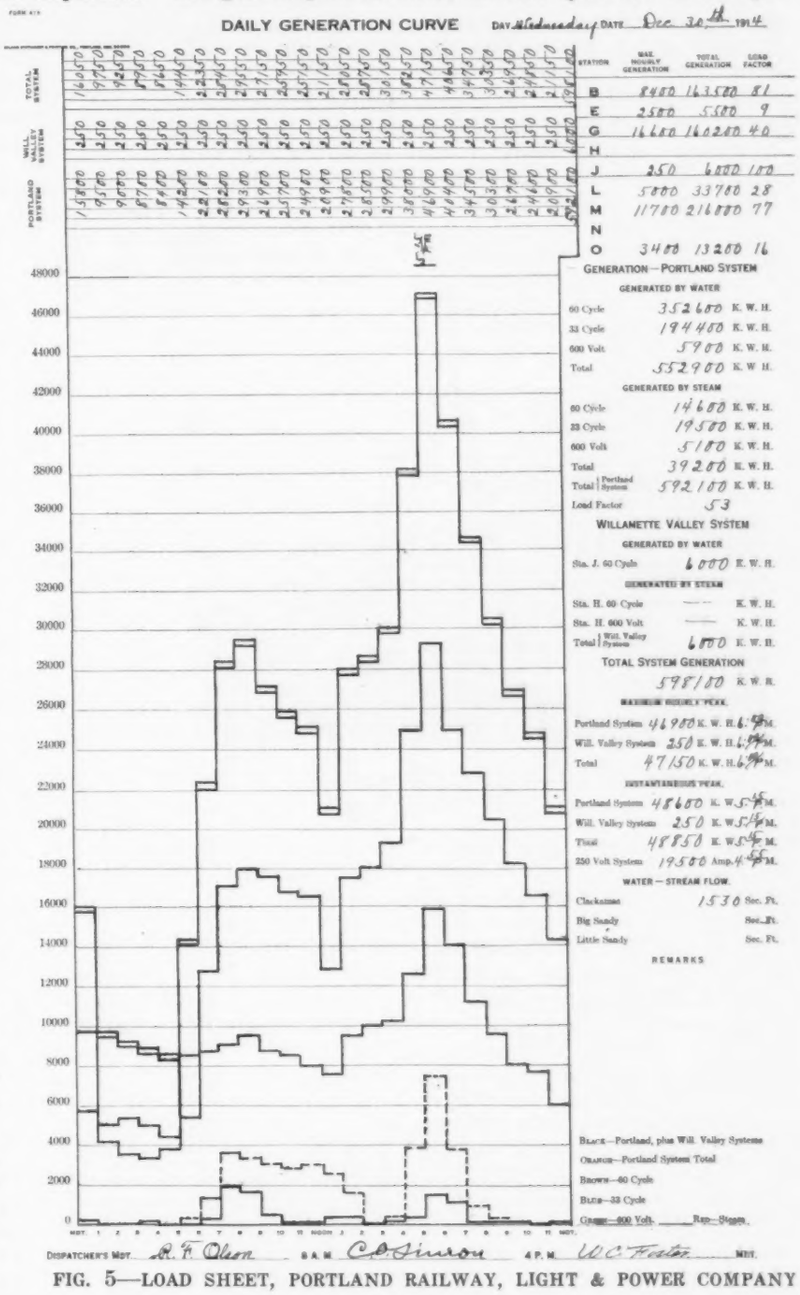

DAILY GENERATION CURVE
Wednesday
Dec 30th 1914
STATION
MAX. HOURLY GENERATION
TOTAL GENERATION
LOAD FACTOR
B 8400 163500 81
E 2500 5500 9
G 16500 160200 40
H
J 250 6000 100
L 5000 33700 28
M 11700 216000 77
N
O 3400 13200 16
GENERATION—PORTLAND SYSTEM
GENERATED BY WATER
60 Cycle 352600 K. W. H.
33 Cycle 194400 K. W. H.
600 Volt 5900 K. W. H.
Total 552900 K. W. H.
GENERATED BY STEAM
60 Cycle 14600 K. W. H.
33 Cycle 19500 K. W. H.
600 Volt 5100 K. W. H.
Total 39200 K. W. H.
Total Portland System 592100 K. W. H.
Load Factor 53
WILLAMETTE VALLEY SYSTEM
GENERATED BY WATER
Sta. J. 60 Cycle 6000 K. W. H.
GENERATED BY STEAM
Sta. H. 60 Cycle —— K. W. H.
Sta. H. 600 Volt —— K. W. H.
Total Will. Valley System 6000 K. W. H.
TOTAL SYSTEM GENERATION
598100 K. W. H.
MAXIMUM HOURLY PEAK
Portland System 46900 K. W. H.
Will. Valley System 250 K. W. H.
Total 47150 K. W. H.
INSTANTANEOUS PEAK
Portland System 48600 K. W.
Will. Valley System 250 K. W.
Total 48850 K. W.
250 Volt System 19500 Amp.
WATER—STREAM FLOW
Clackamas 1530 Sec. Ft.
Big Sandy Sec. Ft.
Little Sandy Sec. Ft.
REMARKS
Black—Portland, plus Will. Valley Systems
Orange—Portland System Total
Brown—60 Cycle
Blue—33 Cycle
Green—600 Volt
Red—Steam
DISPATCHER'S MGT. A. F. Olson 8 A.M. C. O. Simon 4 P.M. W. C. Foster MGT.

FIG. 5—LOAD SHEET, PORTLAND RAILWAY, LIGHT & POWER COMPANY

Motor Drive in Oregon Woolen Mills

The Portland Woolen Mills at St. Johns, Ore., have just been electrified, having been converted from steam to central-station electric drive throughout. These mills are among the largest in the West and have a total load averaging about 250 kw.

SUPERVISING 840 MILES OF LINES

How the Load Dispatcher of the San Joaquin (Cal.) System Adjusts Even Plant Water Supply—Co-operation of Commercial Department

BY L. J. MOORE, CHIEF LOAD DISPATCHER

Up to the beginning of 1911, the San Joaquin (Cal.) Light & Power Corporation's transmission system consisted of a 30,000-volt network which extended from the generating station in the Crane Valley district, about 40 miles north of Fresno, Cal., down into the San Joaquin Valley, serving Fresno, Madera, Merced, Selma, Hanford, Reedley, Coalinga and some other towns. In those days the operator at the Fresno substation usually directed the switching and the operation of the system. In times of trouble, however, some member of the engineering department was often called upon to help get the system back into service. Early in 1911 a period of general expansion and extension was entered upon by the company, owing to the fact that the rebuilding of the reservoir and the old No. 1 generating station in the Crane Valley district gave a large additional block of power which must be marketed. The system rapidly became too complicated for the operators to

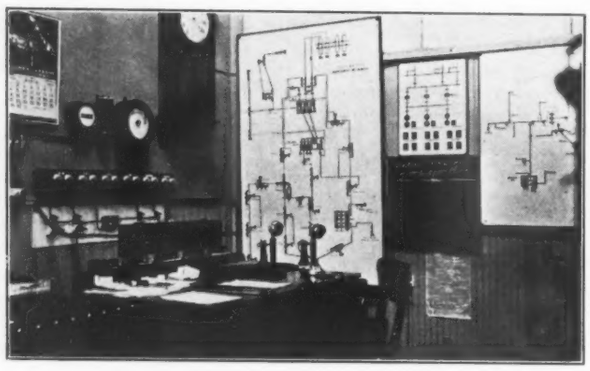


FIG. 1—LOAD DISPATCHER'S OFFICE, SAN JOAQUIN LIGHT & POWER SYSTEM

handle, and hence, in order to secure concerted action in case of trouble, the load dispatcher's department was created. At first a dispatcher was kept on duty only in the day and over the peak in the evening, but the period covered has been gradually extended until the entire twenty-four hours are covered by three equal shifts.

The present system of the company consists of about 560 miles of 60,000-volt lines and 280 miles of 30,000-volt lines, making a transmission total of 840 miles. There are at least 1000 miles of distribution lines, operated at 2300, 4000 and 11,000 volts. There are operated four hydroelectric plants, one large steam-reserve plant, and three small steam plants which have been acquired by purchase during the period of extension. There are some thirty distribution and switching substations. Private telephone lines are erected under all the transmission lines. These telephone lines terminate at the dispatcher's office in Fresno, giving him communication with all the operators, patrolmen and others dealing with the operation of the system.

The lines are arranged according to the ring system, with two main 60,000-volt lines extending south from the Crane Valley power houses, which are at the northern extremity of the system, over the same right-of-way to the Copper Mine switching station, at the edge of the mountains. There they separate, one going on south along the west side of the valley through the Midway and McKittrick oil fields to Bakersfield, the southern end of the system, and the other reaching the same destination along the eastern side of the valley. At Bakersfield, conveniently situated near a plentiful supply of fuel oil, is the steam reserve plant. The Kern Canyon hydroelectric plant is also connected to the system through one of the 10,000-volt lines radiating from the Bakersfield steam plant. About midway between the Copper Mine and Bakersfield on the west 60,000-volt line is the Henrietta substation, from which a 6000-volt line extends westward through Coalinga, over the Coast range, and then southward along the coast through San Miguel, San Luis Obispo and Santa Maria. At the end of this line are the steam plants of San Luis Obispo and Santa Maria. About midway of the east 60,000-volt line from Copper Mine to Bakersfield is the Strathmore switching station, through which the Tule River power house is connected to the system.

Steam Plants Used Only in Emergency

The old 30,000-volt system is connected through step-down transformers to the 60,000-volt lines at Copper Mine and Henrietta substations. The distribution substations are quite uniformly situated over the system, giving a fairly even distribution of load. It is expected some time in the future to build a 60,000-volt tie line between the Henrietta and Strathmore substations, transforming the valley system into a "figure 8" instead of a ring system, and thus greatly increasing the reliability of the service.

It is, of course, the policy to carry all the load by water-power, if possible, and to run the steam plants only in emergency. The load carried by each plant is determined by its local conditions. The Kern Canyon power house is an old plant, and at its present state of development is never able to utilize all the water available. Hence it is operated at full load, 1400 kw, constantly. The Tule River power house, of 6000-kw rating, the newest one of all, is built on a river having small storage facilities, and therefore its load is determined at all times by the water in the river. In high-water times the plant is overloaded if necessary to relieve the load on the plants that have storage reservoirs, thus allowing them to store water. The watershed on the Tule River development extends from the 4000-ft. elevation up to about the 10,000-ft. elevation. The precipitation in winter is very heavy, especially at the higher altitude, where very deep snow falls. As a result the Tule River has a more even flow throughout the year than almost any other river coming out of the Sierras in California. Only one fork of the stream is developed at present; when the work on the other is finished the quantity of water available will be about doubled. The San Joaquin (formerly called No. 1) and No. 3 power houses, of 16,000-kw and 2000-kw rating respectively, are supplied with water from the Crane Valley reservoir, on the north fork of the San Joaquin River. This means that the amount of water supplied may be varied at will, so these plants take care of variations of load and speed. The Crane Valley reservoir has a storage capacity of about 50,000 acre-ft., and its watershed extends from the 3200-ft. elevation up to about the 8000-ft. level. The storage available is sufficient to operate both plants up to the full-load rating during the peaks, and with all the load called for under present load-factor conditions at other times, for a period of about 225 days per year. Even in a year of light rainfall the water in the streams during the dry season is ample to fill out the remainder of the year. The Bakersfield steam plant is at present able to carry a load of some 12,000 kw, and is the large steam reserve for the system. For economy, the boilers are not kept under steam pressure, and the plant is connected to the line only in case of emergency. The San Luis Obispo and Santa Maria steam plants are able merely to take care of their own local load in each case, and hence are seldom used except in case of failure of lines furnishing hydroelectric

energy to them. The Fresno steam plant of 600 kw rating, is held as a reserve for the system of the Fresno Water Company and the street-railway system.

The voltage regulation is taken care of by a Tirrill regulator at the San Joaquin power house. With the Bakersfield plant off the line, voltage regulation on the south end of the system was very poor, and it was decided to drive a 2500-kva turbo-generator by a motor at Bakersfield in an attempt to improve the operating conditions. Two problems were involved: to start the unit again, should it be dropped from synchronism during line trouble, and to keep the turbine blades cool, because the construction of the unit did not make it feasible to uncouple the generator from the turbine. The starting problem was solved by keeping a single boiler under pressure and bringing the unit up to speed from the steam end. It is a necessity to keep steam in one boiler in any event in order to be able to manipulate the oil pumps on the other boilers when the whole plant must be rushed into service. The cooling of the turbine blades was accomplished by the simple expedient of diverting the air from the ventilating fans on the generator rotor from the generator case through a pipe into the turbine case, which is operated with all of the ports open. This plan works very satisfactorily. In case the machine drops out of step with the line, it is necessary merely to close the turbine ports, turn on the steam, and synchronize again. The other two turbines can carry all the load the present boilers can furnish, and hence the output of the plant is not curtailed. The synchronous-condenser effect obtained has solved the voltage regulation problem.

One of the hardest problems encountered in the operation of this system is the handling of the water supplied to the plants in the Crane Valley district in such a way that none shall be wasted. Ten hours are required for water from the reservoir to pass the lower plant, so the load must be foreseen some time in advance and the proper amount of water be delivered at the right time. There are small regulating reservoirs at the head of the penstocks to both plants, but they have insufficient storage capacity to carry the load for any great length of time. Water from No. 3 power house must flow through the natural channel of the north fork of the North Fork of the San Joaquin River some four miles, until it reaches the intake to the flume of the San Joaquin plant. This is where the flow is slowest and much time is required.

When No. 2 power house, which will utilize the head between the two present power houses and is now under construction, is completed, the entire distance from the reservoir in Crane Valley to the San Joaquin plant will be covered through flumes and concrete-lined ditches and tunnels, thus cutting down the time for the water to pass all the plants.

The two forks of the North Fork of the San Joaquin River join at too low an elevation for all of the water of the south one to be turned into the Crane Valley reservoir, but there is a small reservoir on it, so arranged as to be turned into the ditch of the San Joaquin plant. There is available about 18 acre-ft. of water in two hours' time, and frequently this amount proves highly valuable in overcoming difficulties.

The regulating of ditches and other water matters is under the direction of a stream gager, who records data on stream flow, rainfall and other matters in that connection. He works in conjunction with the load dispatcher, who keeps him informed of premeditated shutdowns, load changes and the like.

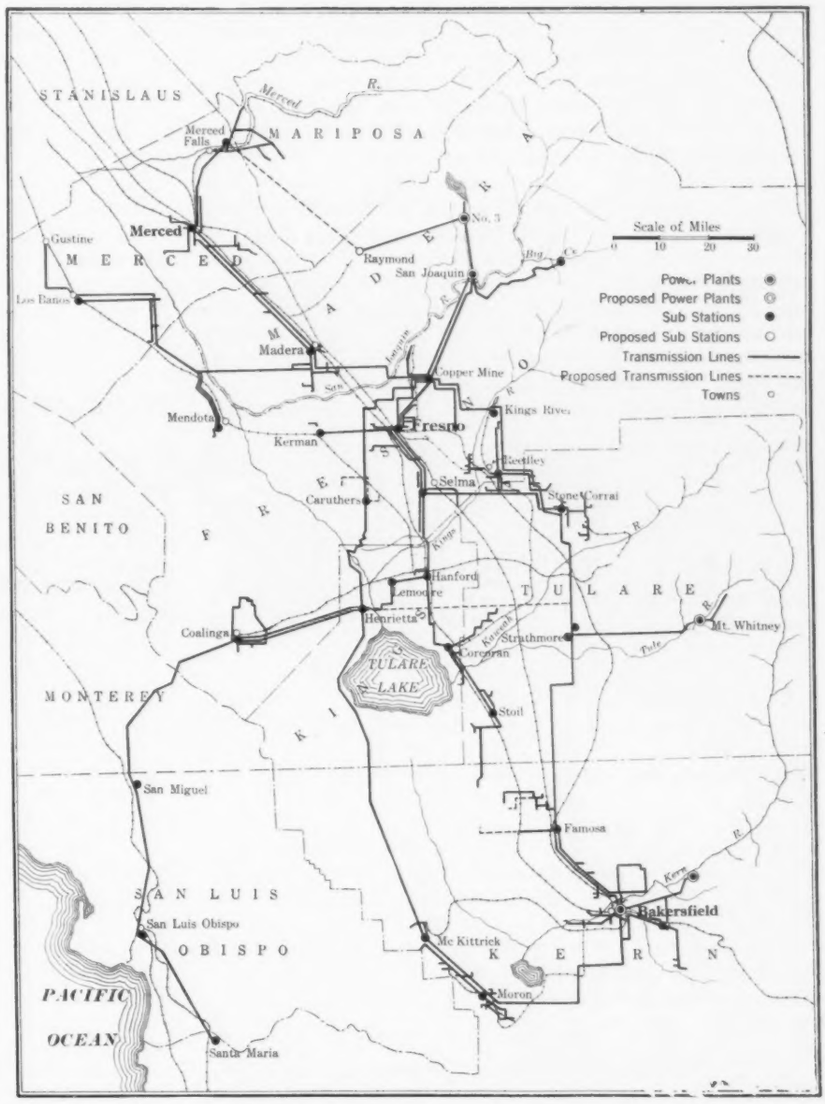


FIG. 2—MAP OF TRANSMISSION SYSTEM OF THE SAN JOAQUIN COMPANY

Transmission line patrols are made under direction of the load dispatcher's office. All lines are patrolled once a month, and certain sections in rough country where troubles are likely to be frequent are patrolled oftener. A patrol crew consists of a lineman and a helper, who carry enough tools and material to make minor repairs as needed. By means of the private telephones, the crews keep in touch at all times with the dispatcher, who renders the lines "dead" for them in case they discover any troubles. The larger cases of trouble are usually taken care of by the line crew in the adjacent district.

In order for the dispatcher to keep in close touch with the movements of patrol crews, note positions of

switches, etc., he is provided with a dummy board, on which are shown all transmission lines, power houses and substations. Switches are indicated by automobile curtain fasteners and are shown open or closed according to whether the fastener is turned across the line or parallel with it. The voltages of the lines are indicated by colors, yellow being 60,000 volts, black 30,000 volts, and green 11,000 volts. The board is supplemented by maps of the lines, showing pole numbers, towns through which the lines pass, and the location of emergency material along them. Thus, when a patrolman gives the number of the pole from which he telephones, the dispatcher knows his exact location.

Another board shows the apparatus in the Bakersfield steam plant. Pieces of apparatus out of commission are indicated by placing targets over the symbols representing them on the board. The steam-plant operators keep the dispatcher fully informed, so that the board always shows the exact conditions of each plant, and he can tell at a glance what he can expect from a plant in an emergency.

No distribution-line switching is handled by the load dispatcher except in the 11,000-volt network which centers in Fresno. This network is fed into through four different substations, with a fifth soon to be joined in with them. This method involves so many different districts that, in order to avoid confusion and to prevent two different crews trying to work on the same line at the same time without the proper switching, the dispatcher's office has been placed in charge of the operation. Use is made of a third dummy board, showing all substations involved and all sectionalizing switches in this network, arranged on the same plan as the transmission line board.

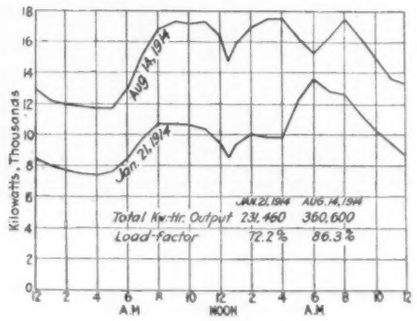


FIG. 3—TYPICAL DAILY LOAD CURVES OF SAN JOAQUIN SYSTEM

Load curves of both the plant outputs and the total output are plotted, and the load-factor and other usual operating data are computed each day by the dispatchers. It is interesting to note that the daily load factor varies from not lower than 70 per cent in winter to as high as 87 per cent in summer. The system load consists of three distinct parts, as follows: First, the usual lighting and industrial motor load to be found in all towns of moderate size; second, oil-well pumping load in the oil-producing districts of the valley, and, third, irrigation pumping load in the rural districts. The two latter parts are well worthy of special mention. The oil-well pumping load constitutes from one-fourth to one-third of the total system load. It is an ideal load, being practically steady throughout the twenty-four hours for almost every day in the year. About the only variation of load at a well occurs when it is necessary to pull the casing out of the well, at which time the demand for energy is increased considerably for a short period. Were it not for these variations, the load-factor of the oil-well load would be practically 100 per cent. The irrigation pumping load forms about the same proportion of the total load as the oil-well load, and while it is heaviest through the dry summer season, its load-factor is practically as high. This high load-factor has been obtained by offering seasonal rates for pumping and featuring a rate for twelve months' continuous pumping. This rate is the one usually accepted by the farmer, because he can save money by building a reservoir and pumping into it continuously, thereby using a motor of not over half the size which would be necessary if he pumped only during daylight hours directly into the ditches. He may also use the power in the winter to pump water for short crops if he desires, at no extra expense. Hence, during the irrigating season the majority of the pumping plants connected seldom stop.

A copy of the load curves for each day goes to the head of the new-business department of the company in order that he can study it with a view to contracting for industrial motor load in such a way as to fill out the valleys in the curve as much as possible.

The load-dispatching department of the San Joaquin Light & Power Corporation is still more or less in the formative state, but of the value already received from it in systematizing operation and improving service there can be no doubt. It is hoped to have it keep pace with the growth of the system and its load, and make it even more useful hereafter.

Operating Washington Coal Mines with Central-Station Power

During the last twelve months the Puget Sound Traction, Light & Power Company of Seattle, Wash., closed a number of motor-service contracts with coal-mining companies, and it now furnishes central-station energy to a coal-mine load totaling about 4000 kw. The largest single mine has about 1000 hp in motors installed. With the development of the coal-mining industry in Washington, the company expects to increase this class of business considerably.

In commenting on this latter-day hydroelectric feat of seemingly "carrying coals to Newcastle," Mr. H. J. Gille, sales manager of the company, points out that with water-power his company is actually able to compete with isolated plants at the coal mine using their own coal.

"We have succeeded," Mr. Gille says, "in proving that the value of the coal burned under the boilers in the isolated plants at the mines, taken with labor costs, investment and depreciation, makes the cost of power generated locally more than the same power could be purchased for from our company. This coal-mining business is, moreover, profitable from the central-station viewpoint, since it is all 'off-peak,' the only energy used during the peak load being the small demand required for lighting purposes."

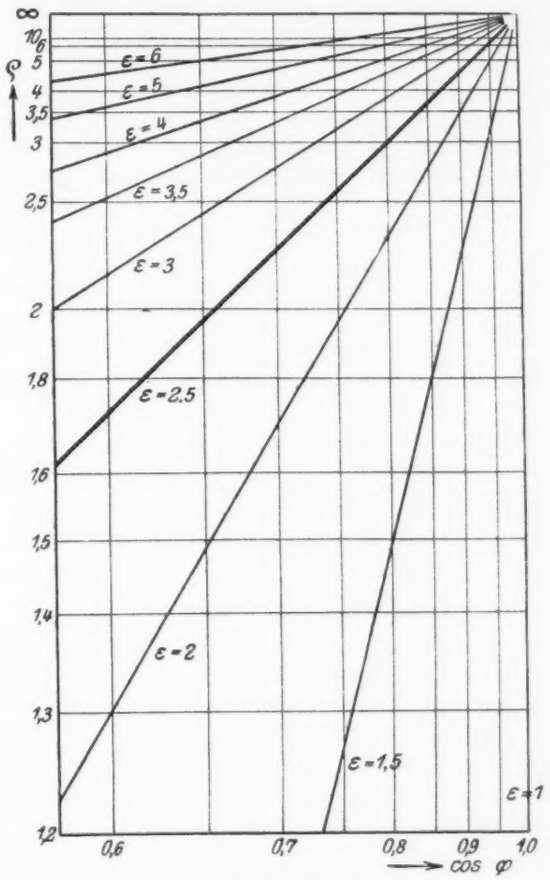
A Big Dredging Job at Vancouver, Wash.

All filling material for the approach to the new interstate bridge which is to span the Columbia River between Vancouver, Wash., and the Oregon shore is to be handled by an electrically operated dredge and pump, the sand and gravel being taken from the bed of the river and transported in flumes a distance of 10,000 ft., or nearly two miles, by motor-driven pumps. The elevated roadway and fill is being built by the Tacoma Dredging Company, which will purchase its energy from the Portland Railway, Light & Power Company. An advance estimate indicates that from 2,500,000 kw-hr. to 3,000,000 kw-hr. will be required for this work.

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Disconnecting Induction Motors.—REINHOLD RUEDENBERG.—It has sometimes happened that windings of induction motors were destroyed by rises of voltage on disconnecting the motor in such a way that the rotor circuit was first opened across the starting resistance and the main switch connecting the motor with the supply circuit was opened afterward. The reason for the comparatively high rise of voltage which occurs in disconnecting the motor in this way is the high magnetic-field energy of the induction motor, which is much greater than that of a transformer of the same rating. By means of theoretical analysis and oscillographic tests



RELATION OF INDUCED VOLTAGE TO CIRCUIT CHARACTERISTICS

the amount of the rise of voltage is determined as a function of the resistance in the rotor circuit. The diagram gives the results of the analysis. The abscissas are the power-factor cos ϕ, the ordinates are the resistance ρ in the rotor circuit, as multiple of the normal starting resistance; that is, ρ is the ratio of the rotor resistance on disconnecting to the resistance required to start the motor with normal torque. The scales for the abscissas and ordinates are arbitrarily chosen in such a way that the curves ε become straight lines, ε being the ratio of the theoretical maximum voltage possible in sudden rise of voltage to the normal voltage. A practical rule is that the motor should not be disconnected in such a way that ε is greater than 2.5. In other words, the power-factor and the rotor resistance must be chosen in such a way as to remain below the straight line $\varepsilon = 2.5$ in Fig. 1. For instance, for a motor the power-factor of which is 0.85, the rotor resistance on disconnecting should not be more than 3.7 times the normal starting resistance to avoid any danger of an accident.—*Elek. Zeit.*, April 15, 1915.

Bearings of Electrical Machinery.—ANDREW GIBSON.—A paper, illustrated by many diagrams, read before the West Scotland Branch of the (British) Association of Mining Electrical Engineers. After a general introduction on bearings of electrical machinery, the author deals with anti-friction metals, seizing, aligning of bearings, ball bearings, plumber blocks, and thrust bearings.—*Iron and Coal Trades Review* (London), May 7, 1915.

Lamps and Lighting

Good Lighting.—V. H. MACKINNEY.—An abstract of a paper read before the Yorkshire local section of the Institution of Electrical Engineers. The author points out that the reflection of surroundings plays an important part in the resultant illumination, and it is quite possible to obtain an increase of as much as 80 per cent over the calculated values due to reflection from the walls and ceiling if the room is within reasonable size and the surroundings are light in character. The following table indicates the amount of assistance one may expect from different surroundings:

Condition of Ceiling	Condition of Walls	Increase Over Calculated Illumination, Per Cent
Very dark	Very dark	0
Medium	Very dark	15
Medium	Medium	40
Very light	Very dark	30
Very light	Medium	55
Very light	Very light	80

The author gives a long table in which average foot-candle intensities are recommended for different classes of service. From this table the following figures are taken: For residences, lighting of the porch, 0.5 ft.-candle; hall, 1.0; drawing room, 1.5; sitting room, 1.5; dining room, 0.5 in general and 4.0 on the table; kitchen, 2.0; bedroom, 1.0 in general and 4.0 on dressing table. For shop windows containing light goods the intensity should be 8 ft.-candles, for medium goods 16, and for dark goods 20. The minimum illumination at any point should not be less than half the values stated. The preferable method of rating seems to be the rating of lamps in terms of quantity of light emitted, *i.e.*, lumens—a lumen being equal to 0.0796 spherical candles; but the most understandable rating would be in mean spherical candle-power. The mean spherical candle-power may then be considered as a measure of the total flux of light, m.s.cp $\times$ 4 = total lumens emitted, and thus one source would be directly comparable with another. The author discussed the different kinds of globes and said that clear glass with correctly designed prisms affords a means of controlling light to the greatest extent and redirecting it more efficiently than any other known material. An account of the discussion which followed is also given.—London *Elec. Review*, April 30, 1915.

Incandescent Lamps.—A note on a recent British patent (No. 17,326, 1914) of I. Langmuir for high-efficiency gas-filled lamps, in which a small quantity of mercury or other substance is contained in the bulb, which vaporizes as soon as the lamp is hot. This vapor has an even better effect than inert gases, such as nitrogen, in preventing the volatilization of the filament.—London *Elec. Eng'ing*, April 29, 1915.

Installations, Systems and Appliances

Use of Profits in Relieving the Taxes of Municipal Plants.—An editorial on the unsatisfactory policy of

relieving taxes by using the profits of municipal electric undertakings for this purpose. If there is any considerable profit from an electric plant, after adequate provision is made for the maintenance of reserve and contingency funds, the tariff should be lowered so as to give the consumers the advantage; otherwise, consumers are made to pay an unnecessarily high price for their energy for the benefit of the ratepayers in general. It is pointed out that the conditions under which municipal undertakings are now being carried out in Great Britain are abnormal, especially with respect to the restriction of extensions and the greatly increased cost of operation, owing to the increase in the price of coal and the higher wages for labor. It is thought that the wisest policy of municipal systems would be to keep all the profits in hand as a reserve against contingencies.—London *Electrician*, May 7, 1915.

Motor Control.—A note on a recent British patent (No. 624, 1914), issued to G. Ellison and M. R. H. Mueller, for an automatic cut-out for crane motors to break the circuit on an undue rise in speed of the motor. The controlling solenoid is provided with two windings, one in shunt with the armature and the other in series with it, so adjusted that in case a high back-emf is produced on high speed with low load, such as when a heavy load is lowered too fast or a light load raised too quickly, the circuit is broken.—London *Elec. Eng'ing*, April 29, 1915.

Rheostatic Control of Separately Excited Generators.—L. Boothman.—If the whole regulation of a separately excited generator is to be obtained with an exciter field rheostat alone, such a rheostat must have a large number of steps of resistance. The author describes two designs of rheostats, with a large enough number of steps to allow the resistance being stepped out evenly over the whole range, but without requiring a large amount of space.—From *British Westinghouse Gazette*, reprinted in London *Electrical Review*, May 7, 1915.

Protective Devices.—E. Kilburn Scott and L. F. Fogarty.—A paper read before the (British) Association of Mining Electrical Engineers on protective devices against lightning and surges, giving brief illustrated descriptions of the principal types of devices.—London *Electrician*, May 7, 1915.

Wires, Wiring and Conduits

Tower Foundations for Transmission Line.—Ira W. Dye.—A long illustrated description of the tower foundation for the Cristobal-Balboa transmission line of the electric distribution system of the Panama Canal.—*Proc. Eng. Soc. of Penna.*, January, 1915.

Wiring for Colliery Electric Lighting.—G. S. Corlett.—A paper read before the North Staffs Branch of the (British) Association of Colliery Managers. After a discussion of the British home office rules, the author deals with the leading points in colliery surface lighting. The essentials of a properly arranged distribution system are: (1) That feeder cables should be run from a main switchboard or main control board to suitable double-pole distributing fuse boxes; (2) that no lamps should be connected to the feeder circuits, and (3) that branch circuits for not more than ten points should be run from the distribution boxes to the lamps. The best method of protecting the internal wiring at a colliery is by means of well-arranged screwed piping. For particularly exposed or damp situations galvanized piping should be used. The author then deals with unsuitable fittings and defective maintenance. Pressures of 100 volts to 110 volts are considered to be the most suitable. The author then discusses underground lighting, and remarks that the multiple lighting at 100 volts to 110 volts will be satisfactory under most conditions. As to the protection of underground wires he declares that, excepting concentric wiring, practically all colliery underground lighting wires must be protected with a metallic covering inclosing the whole of the conductors in the circuit. Speaking broadly, the choice of this protection is limited to two types—steel tubing and armoring of the cables. Excepting on masonry or on the steel-girdered roofs of motor houses the use of tubing is inadvisable. It is worse than useless on the average timbered roadway where there is the slightest liability of movement. The twin-armored system has been found satisfactory by the author in various oscillations. Concentric wiring is permissible, but up to the present only a relatively small amount of such work has been done underground. The success or failure of such a system depends entirely upon the attention given to the design of the necessary joint boxes and other fittings. A concentric system in which the outer conductor is further protected by cab-tire sheathing has recently been put forward for use in this class of work. This type of protection has been largely used underground for coal-cutter trailing cables, and has been found to stand successfully the extremely severe conditions of that service; hence it seems quite probable that such protection may be suitable for lighting purposes.—*Iron and Coal Trades Review*, May 7, 1915.

Electrophysics and Magnetism

Atomic Model with a Magnetic Core.—H. Stanley Allen.—A paper suggesting a new atomic model which consists of a ring or rings of electrons surrounding a central core having a radius considerably greater than the nucleus of the Rutherford atom, and in consequence capable of producing appreciable magnetic forces in its vicinity. The total charge of the core must be equal to Ne, where N is the atomic number and e the electronic charge. The magnetic moment of the core arises from the orbital motion of the discrete electrified particles (α particles, β particles, hydrogen nuclei or positive electrons) of which it is composed. The diamagnetic properties of the atom arise mainly from the external electrons revolving in orbits whose radius is of the order 10^{-8} cm. The magneton is regarded not as an independent entity, but as a unit convenient for measuring magnetic moments introduced in consequence of the principle of the constance of angular momentum.—*Phil. Mag.*, May, 1915.

Magnet Steel.—S. P. Thompson.—An illustrated (British) Physical Society paper on the criterion of steel suitable for permanent magnets.—London *Electrician*, April 16, 1915.

Units, Measurements and Instruments

Projection Instrument.—J. A. Fleming.—A brief abstract of a (British) Physical Society paper on an instrument for the optical delineation and projection of physical curves such as hysteresis, resonance and characteristic curves.—London *Electrician*, April 16, 1915.

Solving Equations.—J. Bethenod.—A brief article on a new principle for the design of an electric machine for solving numerical equations of any degree.—*La Lumière Elec.*, April 10, 1915.

Telegraphy, Telephony and Signals

Loading Telephone Lines.—A note on a recent British patent (No. 8134, 1914) of H. B. M. Pleijel and A. H. Olsson, for a method of arranging Pupin coils on duplexed double-telephone lines with the coils in the current lines so constructed that the current of the duplex connections produces in them stray fields which serve to load the main line as branches of the duplex, whereby, with the same set of coils, the double lines are loaded as main lines and as a branch of the duplex lines.—London *Elec. Eng'ing*, April 22, 1915.

NEW APPARATUS AND APPLIANCES

Cast-Metal Fixture for Gas-Filled Lamps

A type of lighting fixture designed especially for use with gas-filled tungsten lamps, and which may be used either with or without a diffusing globe, has been developed by the Herwig Art Shade & Lamp Company, 2138 North Halsted Street, Chicago. The cap of this substantial unit has been made removable to permit speed and convenience in wiring. Even after the fixture has been installed, ready access to the socket can be had by removing the three screws which hold the lower part of the unit in place and lowering the bottom part of the holder.

Free circulation of air within the fixture is assured, the manufacturers claim, by a triple ventilating system, the hoods for which may be seen in the illustration

FIXTURE FOR HIGH-EFFICIENCY INCANDESCENT LAMPS

herewith forming the canopy of the fixture. The parts of the holder are made interchangeable so that fixtures of different sizes may, without rewiring, replace original installations if it is found that different-sized lamps are needed. The units, which the manufacturers have named "ventilites," are made of cast metal and are finished in black enamel. They may be used either outdoors or indoors.

Switch Dial Testing Set

The testing set shown herewith is provided with a removable galvanometer of the D'Arsonval type, a self-contained battery, and a rheostat which consists of four sets of resistance coils, each set having ten coils. Provision is made for measuring resistances in multiples of 10 units, 100 units and 1000 units. Binding posts are provided for connecting the instrument to an outside battery when a potential higher than that provided by the cells in the set is needed. Directions for making tests are printed on a card which is attached to the lid of the set.

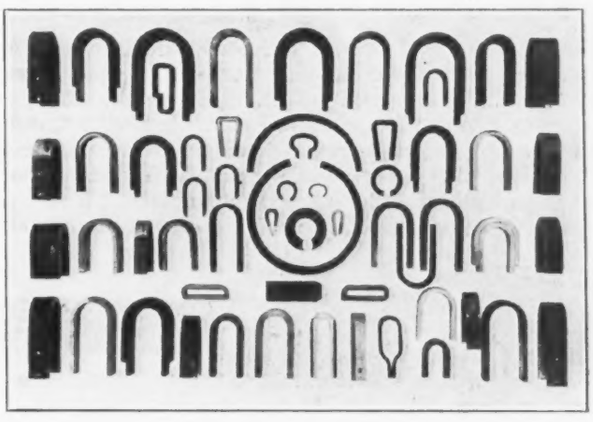
The test switch is so arranged that when a resistance test is to be made the indicator is turned to the position marked "W. B.," which puts the Wheatstone bridge connections in the circuit. By turning the switch to the point marked "V. L." connections are made for a Varley loop test; at "M. L." connections are made for a Murray loop test. The value of the resistance of the particular coil in circuit is shown in a small circular window at the side of the dial handle, and one number only is visible. Each dial is provided with a detent, so that when the brush is completely on the block the position is indicated not only by the value in the window but also by

RESISTANCE TEST SET WITH SWITCH DIALS

the detent, which allows one to tell, by sense of touch or sound, when the brush is in the center of the contact stud. The possibility of misreading the results is eliminated, the manufacturers declare, with this method of indicating the resistance. The instrument is being placed on the market by the Thompson-Levering Company, 322 Arch Street, Philadelphia, Pa.

Permanent Magnets

In the accompanying illustration are shown types of permanent magnets which have been recently developed by the Esterline Company, Indianapolis, Ind. The



SMALL PERMANENT MAGNETS

magnets were designed chiefly for use with electrical instruments and ignition magnetos, and are of tungsten steel. According to the manufacturer, every lot of steel is tested before being used, and every magnet is subjected to magnetic tests after its completion.

Shade-Holder-Type Reflectors

The Benjamin Electric Company, of 120 South Sangamon Street, Chicago, has developed a line of steel-enameled reflectors in which it has been the aim of the

FIG. 1—FLAT-CONE REFLECTORS

company to combine high efficiency and graceful outline. These reflectors are made in flat-cone, fluted,

FIG. 2—BOWL REFLECTORS

deep-bowl, shallow-bowl and angle styles and in distributing and focusing types. They may be finished in

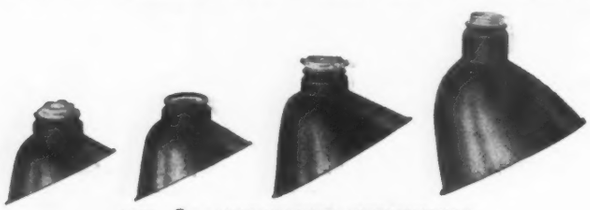
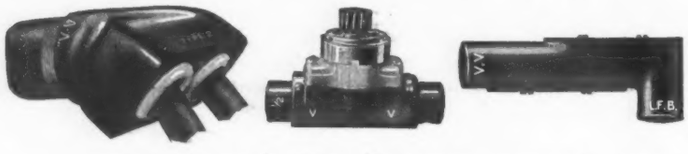


FIG. 3—ANGLE-TYPE REFLECTORS

either green or white enamel or aluminized steel. The "built-in" holders attached to the reflectors are illustrated in the cuts herewith.

Wiring Devices

A number of wiring devices have recently been brought out by the V. V. Fittings Company, 1910 North Sixth Street, Philadelphia, Pa., some of which are illustrated herewith. In Fig. 1 is shown a weather-proof sign fitting. Outlets are provided for from one to six wires at an angle of 45 deg. A straight pull can be obtained on the wires, when connecting up the fittings. "Straight-through" T and "dead-end" fittings with receptacles, snap switches and porcelain nipple covers have also been developed. A straight-through fitting is shown in Fig. 2. The covers of all fittings with attachments are interchangeable. The device shown in Fig. 3 is provided with covers on both sides as shown, so that it can be utilized either as a front or back fitting. A weather-proof device of a similar design is also avail-



FIGS. 1, 2 AND 3—SIGN, "STRAIGHT-THROUGH" AND DOUBLE-COVER FITTINGS

able and is equipped with heavy rubber gaskets which are placed between protruding flanges. A large opening is provided for pulling in the wires to prevent making short bends and kinks in the wire.

Vapor-proof fittings, as they are called, are illustrated in Fig. 4. The single fitting is equipped with an L attachment, by means of which it is possible to adjust the fitting through a number of different angles. The de-

FIG. 4—VAPOR-PROOF FITTINGS

vices are fitted with leather gaskets, which are soaked with oil to make them vapor-proof. The vapor-proof fixtures are especially adapted for use in gas houses, mines and tunnels, and in other damp and dusty places. Re-

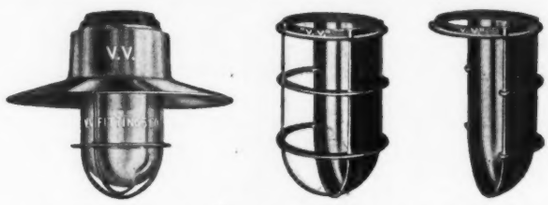


FIG. 5—REFLECTORS FOR VAPOR-PROOF FIXTURES

flectors, reflecting guards and glaring reflectors have also been developed by the V. V. Fittings Company for use with the vapor-proof devices. Several types of reflectors are shown in Fig. 5.

Small Motors for Operating Heat Regulators

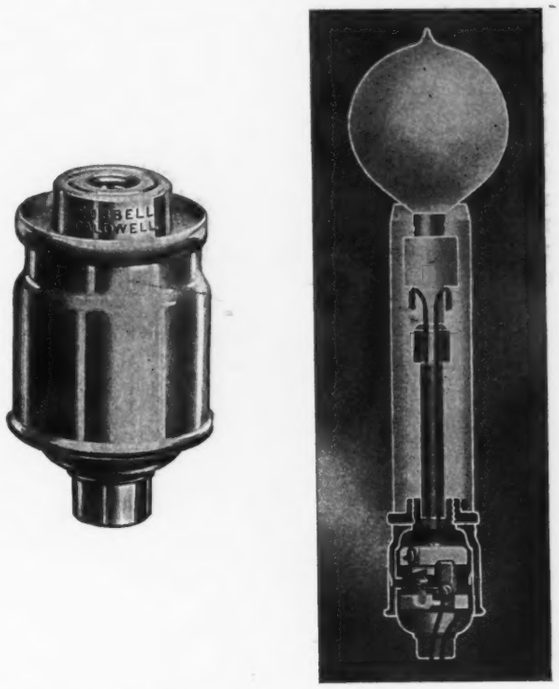
Small alternating-current and direct-current motors for operating heat regulators have recently been developed by the Minneapolis Heat Regulator Company, Minneapolis, Minn. The direct-current machine is operated on a four-cell dry battery, while the alternating-current motor may be connected to any ordinary 110-volt, sixty-cycle lighting circuit. By employing motors, the operation of the heat regulator is made entirely automatic. The motors require no attention, the manufacturer claims, except to be oiled when starting the heating plant for the season and, in the case of the direct-current machine, to renew the battery each fall. The armatures are provided with latches which do away with "chattering," and at the slightest contact of the thermostat points at once allow the motors to make an operation.

SMALL ALTERNATING-CURRENT MOTOR FOR OPERATING HEAT REGULATOR

The motors are incased in dust-proof No. 22 gage steel covers, which are finished in black enamel. The alternating-current motor is provided with a transformer which reduces the voltage to that employed for operating the thermostat and magnet coils.

Rotating Switch

A rotating switch which is designed for ornamental candelabra fixtures where a projecting key or hanging chain would detract from the symmetry and beauty of



FIGS. 1 AND 2—ROTATING SWITCH FOR ORNAMENTAL FIXTURES

the installation is being placed on the market by Harvey Hubbell, Inc., Bridgeport, Conn., and is designated as a Hubbell-Caldwell switch. Rotary movement is provided only in one direction, and the lamp is turned on and off, it is asserted, without jar or vibration. The circuit is closed or opened by means of a sleeve which engages a brass lip projecting from the segment. A special tripping mechanism is provided, which makes it impossible to injure the switch by turning it in the reverse direction. An outside view of the switch is shown in Fig. 1 and a sectional view of the switch and a lighting fixture in Fig. 2.

Bell Transformer

A small low-voltage transformer designed for use in operating bells and door openers in apartment houses is shown in the accompanying illustration. According

TRANSFORMER FOR OPERATING BELLS AND DOOR OPENERS

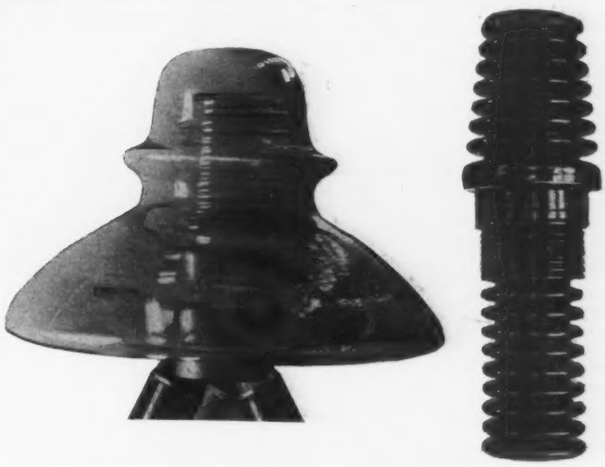
to the manufacturers, the Jefferson Electric Manufacturing Company, 847 West Harrison Street, Chicago, Ill., the core loss is less than 0.75 watt and is therefore too small to be registered on the ordinary watt-hour meter.

Insulator Tests

Insulators of a special composition material called "boro-silicon," which was described in the ELECTRICAL WORLD of April 3, have recently been put under tests, and the results obtained are reported as follows:

Four 11-in. suspension units were tested, and each unit was subjected to an increasing mechanical strain (pull) starting at 6000 lb. and ascending in steps of 1000 lb. and 2000 lb. At the same time, the insulators were subjected to a potential of 60,000 volts. None of the units punctured during the tests.

Unit No. 1 stood a mechanical electrical test up to 12,000 lb. without any sign of break-down. Unit No. 2 stood a mechanical test up to 11,000 lb. Just after 12,000 lb. had been applied the unit pulled apart, shearing the material evenly in a cleavage plane at an angle about 60 deg. from the vertical and reaching a point about 0.5 in. from the bottom of the cap. Unit No. 3 stood a mechanical-electrical test up to and including 12,000 lb. Unit No. 4 tested satisfactorily at 11,000 lb., but upon the application of 12,000 lb. the eye-bolt pulled out of the cement of the insulator. The unit was still good electrically. Three of the units were subsequently given an electrical test only, and it was found that a dry flashover of one disk took place at a pressure of 115,000 volts, and of two glass disks in series at 198,000 volts. All the insulators were tested



FIGS. 1 AND 2—INSULATOR AND BUSHING OF COMPOSITION MATERIAL CALLED "BORO-SILICON"

under oil without puncture. The maximum voltage obtainable, owing to leakage and flashing around the insulator or to the containing vessel, was, however, only 170,000 volts, and none of the units were punctured at this voltage. The insulators were made by Fred M. Locke, Victor, N. Y.

Automatic Starters for Small Alternating-Current Motors

Automatic starting switches designed for the remote control of small alternating-current motors have recently been developed by the Allen-Bradley Company, Milwaukee, Wis. The starting switch shown in Fig. 1 consists of a two-pole magnetically operated clapper switch mounted on a slate panel. The clappers are held in the closed position by the electromagnet, the terminals of which are connected to the line. Since the circuit to the motor is opened as soon as the electromagnet is de-energized, the starter affords full no-voltage protection. All switches, excepting those of small ratings, are provided with magnetic blow-out coils. The contacts of the clapper are of hard-drawn copper. They are

so shaped and pivoted on a shaft that in closing the switch a long-rolling contact is provided. The magnetic circuit is built up of sheet-steel laminations and is equipped with a shading coil for decreasing the noise

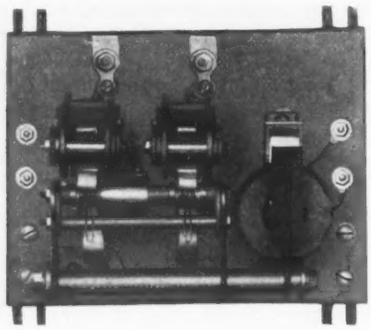


FIG. 1—PLAIN AUTOMATIC STARTING SWITCH

of operation. In Fig. 2 is shown an automatic starting switch which is equipped with two adjustable time-limit overload relays, a line knife switch and fuses. Any kind of a contact-making device, such as a push-button, snap switch, gage-type pressure regulator, float switch or similar apparatus can be used for the operation of this starter. When the line contacts are closed, which in the case of the push-button is done by pressing the starting button, the coil of the clapper switch which

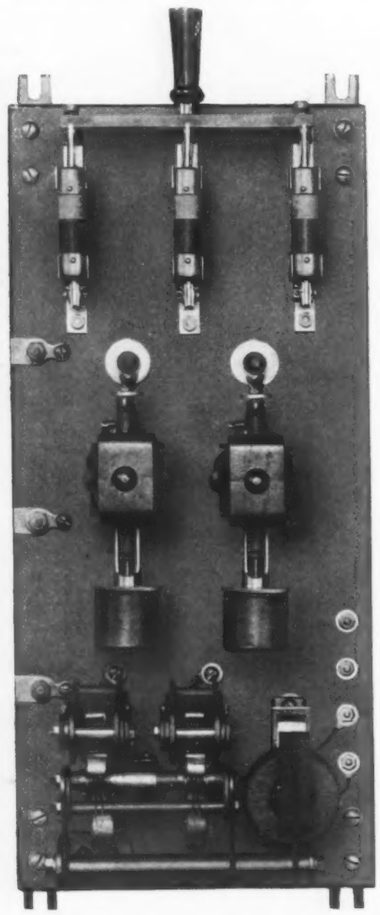


FIG. 2—STARTER WITH LINE KNIFE SWITCH

acts as an electromagnet is energized, and its magnetic pull immediately closes the clappers of the starter. The three-wire push-button system is preferable, the manufacturers claim, since with such a system multiple-station control can be obtained.

Vacuum Cleaner for Working in Small Spaces

The motor of the vacuum cleaner illustrated herewith is mounted well up on the handle as shown, and the machine is adapted especially for cleaning under radiators, heavy furniture, etc. A swivel joint is provided at the bottom of the cleaner so that the handle can be dropped to either side, or even to the floor if necessary. A small felt strip for polished floors and a brush strip for rough floors can be snapped into place in the aperture of the cleaning tool. According to the manufacturers, the Santo Manufacturing Company, Twenty-first Street and Allegheny Avenue, Philadelphia, Pa., a direct passage is provided for the inrushing air to the center of the fan, and the air is discharged radially. The handle is of nickel-plated tubing, closed at one end, and is equipped with a folding clip which forms the

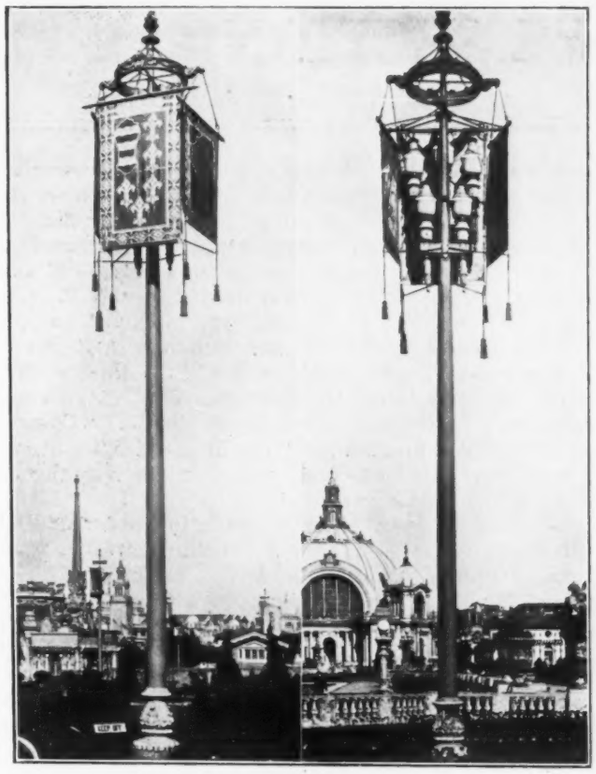
VACUUM CLEANER WITH MOTOR ABOVE THE DUST BAG

upper hook on which the cord is wound. The clip is also utilized for hanging up the cleaner when not in use. The machine is operated by a General Electric motor.

Ornamental Luminous-Arc Units for Illuminating Exposition Buildings

The outer walls of Festival Hall, the Horticultural Building and the nine main exhibit palaces at the San Francisco Exposition are illuminated by luminous-arc lamps concealed behind translucent banners of heraldic design and plaster shields. The banners are placed partly around the lamps and are of such a density as to allow just enough light to pass through to show their designs and colors while the chief flood of light is reflected directly upon the walls of the buildings. The lamps are installed in groups of two, three, five, seven and nine on one standard. The standards vary in height from 25 ft. to 50 ft., to correspond to the height of the walls of the buildings which they are employed to

illuminate. The spacing of the standards ranges from 50 ft. to 65 ft., in conformity with the area lighted and

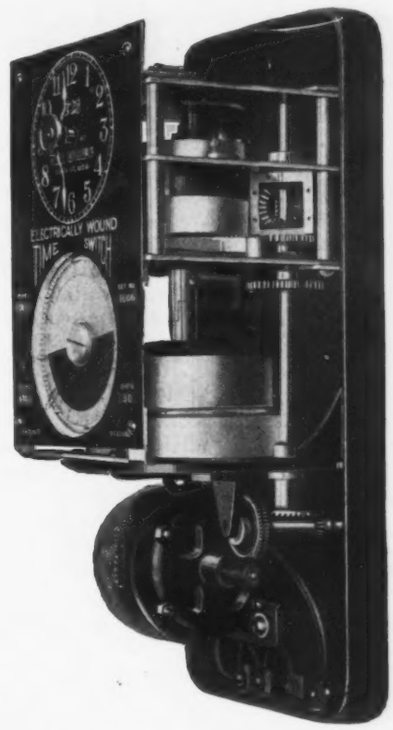


FIGS. 1 AND 2—FRONT AND REAR VIEWS OF BANNER STANDARDS

intensity desired. Solid-wooden poles support the framework or cross-arm on which the lamps rest. A groove is cut in the side of each post for embedding the cable, and the opening is closed by strips of wood. About 900 of these lamps are in operation at the Exposition, each circuit containing approximately seventy-five lamps. The lamps were made by the General Electric Company, Schenectady, N. Y.

Electrically Wound Time Switch

The Minerallac Electric Company of 400 South Hoyne Avenue, Chicago, has developed for the market an electrically wound time switch. Essentially the device consists of a clock with spring and escapement specially designed, a snap switch actuated by the clock mechanism, and a small motor for rewinding the clock. In normal operation the clock is wound for three minutes every four hours, but the spring tension of the clock is sufficient to keep it running continuously for a long period after the electrical energy supply has been interrupted. The manufacturers claim the following features of this device to be distinctive: The clock is wound by an electric motor and requires attention only once in six months for oiling; it is not affected by the most severe temperature changes; the jobber need not carry a variety of stock because the devices for all ratings are identical except for the difference in rating of the snap switches they contain; the clock element is specially designed for the time-switch service; all shafts are mounted vertically; the escapement is unusually sturdy; the device is designed for operation on any type of service, and if the winding circuit is accidentally disconnected the switch will continue to operate for a long period and will automatically fully rewind when the circuit is again energized. The time switches that have been described are suitable for controlling circuits feeding window lighting, street lighting, two-rate



TIME SWITCH WITH CLOCK WOUND BY MOTOR AND SNAP SWITCH ACTUATED BY CLOCK MECHANISM

meter installations, off-peak services, transformer substations, electric pumping stations, vehicle-charging equipment, and other apparatus where automatic time control is needed.

Electric Egg Tester

In the accompanying illustration is shown an electrically operated egg tester which can be placed on a table or counter or can be mounted on the wall. With the exception of the base, it is of metal in construction. The eggs to be tested are placed in felt-cushioned

ELECTRICALLY OPERATED EGG TESTER

receivers as shown, under which is an incandescent lamp and reflector. The tester is provided with a hood so that it can be employed anywhere desired. The device is being placed on the market by the William Rigling Egg Tester & Manufacturing Company, Hamilton, Ohio.

CURRENT NEWS SECTION

N. E. L. A. Convention Train and Program

The "red special" left Grand Central Terminal, New York, at 12:45 p. m. on May 24 for the National Electric Light Association convention, which is to be held in San Francisco on June 7 to 11. The train consisted entirely of compartment cars and was operated as a club. It is a counterpart of a similar special train which carried a number of delegates to the National Electric Light Association convention in Seattle in 1912. The train directory, issued by the Wagner Electric Manufacturing Company, showed that the list of passengers includes many delegates and ladies from various Eastern and New England cities and the Central West. President Holton H. Scott of the association and many others prominent in the industry were on the train. The route of the "red special" is via Chicago, Keokuk, Kansas City, Albuquerque, Grand Canyon, Riverside, San Diego, Los Angeles, Pasadena and Yosemite Valley to San Francisco, which is to be reached at 8 a. m. on June 5. The train is under the personal direction of Mr. Ray D. Lillibridge.

Progress of the "Red Special"

A telegram to the ELECTRICAL WORLD from Lamar, Col., gave the following information about the progress of the "red special" toward its destination:

"One hundred and fifty-eight members of the 'Red Special' Club are proceeding through Kansas on time. Members seem to appreciate greatly the operation of the train on the club principle, the novelty of which has been impressed upon them by visits from numerous railroad officials en route to observe this seeming innovation in railroading. On Tuesday a stop was made at Keokuk, Ia., and the courtesies received at the hands of the Mississippi River Power Company were enjoyed greatly, notwithstanding severe thunderstorms which marooned the party at the plant for a considerable time beyond schedule. Wednesday was uneventful except for a practical joke played on one member of the party at Hutchinson, Kan., by Mr. J. F. Springfield, local manager of Doherty interests, in connivance with some of the members of the club. While the engine was getting water at Hutchinson, a county seat, a member of the party was apparently placed under arrest by the sheriff for infraction of the Kansas sumptuary laws. The discomfort of the traveler, due to the suggestion of remaining for trial and thus having to allow the 'red special' to proceed without him, together with his endeavor to purchase immunity, was enjoyed hugely by the entire company. Courtesies of electrical manufacturers to members of the club have been the subject of constant favorable comment. Scenic views of the route, memorandum pads for the men and flowers for the ladies have been distributed by the Westinghouse Electric & Manufacturing Company; playing cards, post cards and flowers by the General Electric Company, and candy, cigars, club stationery, drinking cups, baggage tags and train directories by the Wagner Electric Manufacturing Company."

Changes in N. E. L. A. Convention Program

Since the publication of the preliminary program of the N. E. L. A. San Francisco convention in the May 1 issue of the ELECTRICAL WORLD several changes have been made. At the technical and hydroelectric sessions on the morning of Wednesday, June 9, the paper entitled "Timber Preservation," by Mr. R. A. Griffin, will not be presented. Two papers originally announced for the accounting session will not be presented—"Standardizing the Accounts of the Pacific Gas & Electric Company," by Mr. M. H. Bridges, intended for the morning session on June 9, and "Analysis of Costs by an Electricity Supply Company for Rate-Making Purposes," by Messrs. A. D. Spencer and R. W. Symes, scheduled for the morning session on June 10. "Charges for Electric Welding Service," by Mr. C. K. Nichols, announced for the commercial session on the morning of June 10, will not be presented.

Paper No. 6, listed under the morning technical and hydroelectric session on June 9, should be entitled "Oil-Burning Standby Plants," by Mr. C. H. Delany. The title of Mr. Paul M. Downing's paper, which will be presented at the same session, is "Water-Power Development on the Pacific Coast," instead of "Oil Burning," as stated erroneously in the preliminary program. The last commercial session will not be held on Thursday, June 10, as previously stated, but on Friday morning, June 11, the program for that day being the one placed incorrectly at the end of the technical and hydroelectric program under the caption "Friday, June 11, 10 a.m.," in the ELECTRICAL WORLD of May 1. The last technical and hydroelectric session will therefore be held on the morning of June 10. The first paper to be presented at the morning accounting session on Wednesday, June 9, entitled "Workmen's Compensation Insurance," will be prepared by Mr. W. G. Cowles, vice-president of the Travelers' Insurance Company, instead of by Mr. R. J. Sullivan, as published previously.

Interruptions in Radio Transmission from Germany

The Nauen-Sayville and Hanover-Tuckerton transatlantic wireless systems, which have been transmitting the bulk of telegraph traffic between the United States and Germany since the cutting of the Emden cable, have for the past two weeks suffered severe service interruptions. Although the plants have been found to be sufficiently powerful to interchange messages, even by daylight, during the winter season, with the coming of warmer weather (and the accompanying increase of "static") communication has become impossible for a large part of each day. The daily press attributes the increased atmospheric disturbances to effects of the aurora borealis and prophesies that normal conditions will not be regained for some weeks. Nevertheless, reports from radio engineers at various points state that "static" is not abnormally bad for warm weather, and it is therefore believed in many quarters that commercial radiotelegraphy between the United States and Germany will not again be possible until autumn.

At the present time the German War Office reports are transmitted through England, and it is likely that such censored relaying will be necessary until the United States stations can again get into regular touch with those in Germany. The Sayville transmitter is being enlarged so as to improve sending to Germany, but this will of course not aid reception in the United

States. Many combinations of receiving apparatus are being tried both at Tuckerton and Sayville, in the hope of eliminating "static" interference to such a degree as to permit the German signals to be read. It is not known whether or not there will be any attempt to increase the sending power of the Nauen or Hanover station. Commercial interests which have made large use of the transatlantic radio during the winter are anxiously awaiting reopening of reliable service.

Dr. Stanley's Tribute to Dr. Pearson

Dr. William Stanley of Great Barrington, Mass., has paid the following tribute to the memory of Dr. F. S. Pearson, whose life was lost when the *Lusitania* was sunk by a German submarine on May 7:

"Quiet, unassuming, almost diffident, Dr. Pearson was possessed of indomitable courage, inflexible purpose, sound as well as wonderful judgment and foresight.

"Probably no other man in creative engineering commanded the confidence of the financial world to an equal extent. Hundreds of millions of dollars are invested in great engineering undertakings in many parts of the world simply because these undertakings bore the stamp of his approval.

"Dr. Pearson was a man of strong living ideals that he lived up to. His great career and his success were due to his thoroughness of thought and deed and his faithfulness to the highest traditions of his profession. He was fearless and bold to a most remarkable degree. He cheerfully attacked the most difficult problems that smaller men shunned, provided that his judgment pronounced them sound.

"I shall not attempt to recount his deeds—they will live long after him—but I strongly recommend young men to search out and read the record of his life's work and his achievements. It is a record of a New England boy's pluck and struggle—a record our country is proud of, a record of a great, strong character in a frail body, a record of nature mastered in many lands, a record broken, alas! by an infamous crime against civilization."

New York Ordinance for Licensing Contractors

A hearing on the proposed ordinance for New York City which provides for the licensing of electrical contractors or the issuing of individual permits to perform definite electrical work, the inspection of electrical work by the city, and the adoption of an electrical code, was held in the City Hall on May 24. Of the central-station, electrical-contracting, underwriting, real-estate, business and other representatives present, the electrical contractors and central-station interests were the most active in the discussion. The electrical contractors were in favor of licensing all persons engaged in the electrical-contracting business, not including the employees of a contractor. Permits for individual contracts were not favored by the electrical contractors, who believed that a license fee of about $50 per year would not work any hardship on the small contractors, and, in fact, would be preferable to the plan to obtain permits for individual pieces of work and thus waste time. Moreover, under certain circumstances, it is necessary to make repairs, etc., immediately. The adoption of a license and permit system, the electrical contractors felt, would tend to decrease the amount of inferior and hazardous wiring done in the city. Much of the hazardous wiring, however, is done by tenants themselves, and in the contractors' opinion it is necessay to take some means for detecting such practices.

The central-station interests were not in favor of the permit and license system, claiming that it would work unnecessary hardships on smaller contractors. They also felt that the standard of electric wiring in New York City was very satisfactory. The central stations were also opposed to inspections of installations by the city, claiming that it meant dual inspections and dual fees, as the city now accepts inspection certificates of the Fire Underwriters.

Organization of the Engineering Foundation

At a meeting of the United Engineering Society at the Engineering Societies Building, New York, on May 25, formal organization of the Engineering Foundation was effected with the following officers: Mr. Gano Dunn, chairman; Mr. Edward D. Adams, vice-chairman; Mr. F. R. Hutton, secretary; Mr. Joseph Struthers, treasurer.

As stated previously in the ELECTRICAL WORLD, the Engineering Foundation has been inaugurated with a gift of $250,000 from Mr. Ambrose Swasey of Cleveland, past-president of the American Society of Mechanical Engineers and famous as a builder of telescopes. The members of the board selected at the meeting to administer the trust, which is to be used "for the benefit of mankind through fostering engineering research," telegraphed to Mr. Swasey appreciation of his gift and a pledge to carry out his aims. Already a number of applications have been received from those who want to make use of part of the funds available for engineering research work. It was decided to be desirable to have a schedule of requirements with which applicants will comply, and the following committee to prepare the form and to consider applications was appointed: Dr. A. R. Ledoux, past-president of the American Institute of Mining Engineers, chairman; Mr. J. Waldo Smith, chief engineer of the Board of Water Supply, Gas and Electricity of New York City; Dr. M. I. Pupin, professor of electro-mechanics, Columbia University, and Dr. Alexander C. Humphreys, president of Stevens Institute of Technology. In addition to the members of the committee, the board is composed of Messrs. Edward D. Adams; Gano Dunn, president of the J. G. White Engineering Corporation; Howard Elliott, president of the New York, New Haven & Hartford Railroad; Dr. Charles Warren Hunt, secretary of the American Society of Civil Engineers; Mr. Charles E. Scribner, chief engineer of the Western Electric Company; Mr. Jesse M. Smith, past-president of the American Society of Mechanical Engineers, and Mr. Benjamin B. Thayer, president of the Anaconda Copper Company.

Right to Examine Cleveland Plant Accounts

The right to examine all the books and records of the municipal lighting plant at Cleveland was given to Mr. J. H. Patton by a decision rendered by the Ohio Supreme Court on May 18. Some time ago Mr. Patton, who is Cleveland manager for Haskens & Sells, public accountants, undertook to make an examination of the books and accounts of the plant. He obtained access to most of the books and records, but the cost sheets were refused on the ground that they were the private property of Mr. F. W. Ballard, Commissioner of Light and Heat.

As a citizen Mr. Patton brought a mandamus suit against the city to compel Mr. Ballard to allow him access to the sheets. The decision of the Supreme Court affirms the decision of the Cuyahoga County Court of Appeals by refusing the appeal made by the city.

Federal Hearings on Exporters' Combinations

The Federal Trade Commission has invited more than eighty persons to appear before it in Boston on June 1 and 2 in connection with the hearings on "combinations of exporters." Among those who have been invited to appear are Mr. Robert Winsor, Kidder, Peabody & Company; Mr. Henry L. Higginson, Lee, Higginson & Company; Dean E. F. Gay, of the School of Business Administration and Finance, Harvard University; Prof. Samuel Williston, Harvard Law School; Prof. C. M. W. Sprague, Harvard University; Mr. Frederick P. Fish, Fish, Richardson, Herrick & Neave; Mr. Walter C. Fish, General Electric Company, and Mr. Everett Morss, president Simplex Wire & Cable Company.

From Boston the commission is to go to New York, where hearings on the same subject will be held on June 3, 4 and 5.

The Pan-American Financial Conference

The Pan-American financial conference, for the expense of which Congress appropriated $50,000, was begun at Washington on May 24. President Wilson opened the sessions in the Pan-American Union building, and delegates from eighteen other American republics were in attendance.

Attempting to solve financial and commercial problems which have been brought to the American republics as a consequence of the European war, the distinguished foreign visitors were in session in Washington during the week, and then started for a tour of some of the Eastern cities of the United States as guests of the government. About 100 American business men identified with important industries were invited to participate in the conference by Secretary McAdoo, who also asked the presence and co-operation of many officials of the government, including members of the Federal Reserve Board and the Federal Trade Commission. Among the business men of this country who accepted invitations to participate in the conferences were Messrs. James A. Farrell, president United States Steel Corporation; Elbert H. Gary, chairman of the board, United States Steel Corporation; Daniel Guggenheim, president American Smelting & Refining Company; E. W. Rice, Jr., president General Electric Company; John D. Ryan, president Amalgamated Copper Company; George P. Toby, A. B. Leach & Company, New York (*vice* A. B. Leach); Calvert Townley, Westinghouse Electric & Manufacturing Company; Frank A. Vanderlip, president National City Bank, New York; J. G. White, president J. G. White & Company, Inc., New York, and James Warren McCrosky, J. G. White & Company, Inc., New York.

The working program of the conference was perfected by the plan of having a number of American business men meet in confidential sessions in committee rooms of the Shoreham Hotel with the foreign delegations of the different countries, one group of Americans to each country. Many of the visitors emphasized the importance of direct steamship connection. The Costa Rican delegation discussed the present needs of public service companies, such as railroad, electric-railway, electric-light and gas companies, and particularly of the financing of public improvements. In regard to the financing of private enterprises in Peru the question of government supervision of public service companies was raised, and the Peruvian delegation said that while the government exercised a general control over such companies it did not intervene unnecessarily, and that the Supreme Court of Peru could always be depended upon to render justice.

Committee on Classification of Technical Literature

Delegates from twenty national technical and scientific societies met in the United Engineering Societies Building, New York City, on May 21, 1915, to perfect a permanent organization to prepare a classification of the literature of applied science which might be generally accepted and adopted by these and other organizations.

The opinion was generally expressed that such a classification, if prepared properly, might well serve as a basis for the filing of clippings, for cards in a card index, and for printed indexes, and that the publishers of technical periodicals might be induced to print against each important article the symbol of the appropriate class in this system, so that by clipping these articles a file might be made easily which would combine these clippings in one system, together with trade catalogs, maps, drawings, blueprints, photographs, pamphlets and letters classified by the same system.

Mr. W. P. Cutter, librarian of the Engineering Societies and a delegate from the American Institute of Mining Engineers, read a paper by request on "The Classification of Applied Science," in which he described the existing classifications. He is the author of one of these. He expressed the opinion that no one of these, although they have excellent features, is complete and satisfactory enough to be worthy of general adoption. He outlined a plan whereby a central office could collate all existing classifications and, with the help of specialists in the various national societies interested, compile a general system which, although perhaps not absolutely perfect, might meet with general acceptance and adoption.

Permanent organization was effected with the following officers: Chairman, Mr. Fred R. Low; secretary, Mr. W. P. Cutter; executive committee, the above, with Messrs. Edgar Marburg, H. W. Peck and Samuel Sheldon. It was agreed that a special invitation to participate by the appointment of a delegate should be sent to other national societies than those represented.

The name adopted is "joint committee on classification of technical literature," and the temporary address of the secretary is 29 West Thirty-ninth Street, New York.

"Electrical Prosperity Week" Plans

Approval of the completed general plans for "Electrical Prosperity Week" was voted by the advisory committee at a meeting in the offices of the Society for Electrical Development, New York, on May 19. Within a short time the society will publish a statement of the proposed plans in a twenty-page booklet, detailing what is expected to be accomplished by the trade campaign.

In the main, prosperity will be the theme of the campaign. On 10,000 billboards will be the message of cheer, optimism, good will and prosperity; in the newspapers and magazines good business will be preached; by the use of store windows, letterheads, postal cards, stamps, pennants, banners, electric signs, etc., more of the public will be reached; electrical-vehicle parades will be held in the large cities; the Lincoln Highway will blaze a trail from the Atlantic to the Pacific, and "white ways" will dominate the celebrations in the larger cities. Central-station companies' plants will hold "housewarmings" where the public will be told of the mysteries of electrical energy and the anxiety of the companies to maintain sufficient supply to accommodate the country. School children will write essays on what they have observed electrical energy do, and "electurettes," issued by the Society for Electrical Development, will be printed by the millions and given to the schools.

Annual Meeting of Electric Power Club

The Electric Power Club, which is engaged in the commercial standardization of electrical machinery and embraces in its membership leading manufacturers of electrical machinery, held its annual convention at Saegerstown, Pa., on May 13, 14 and 15. About forty-five representatives were present.

The principal subject discussed related to commercial temperature rise limits for all classes of electrical machinery. It was recognized that the standardization rules adopted by the American Institute of Electrical Engineers last year represented maximum permissible temperature rise limits and that it was properly the function of the Electric Power Club to determine what temperature standards falling within these limits best meet the actual conditions of commercial practice.

On impregnated fibrous insulation the maximum permissible temperature rise limit of the rules of the American Institute of Electrical Engineers is 50 deg. C. On small fractional horse-power motors, owing to the conditions under which most of these motors are operated, and on single-phase motors and direct-current engine-type generators, the members of the Electric Power Club were in favor of maintaining the present commercial standard of 40 deg. C. They were also in favor of deferring until July 1, 1916, any change in the basis of rating standard electric motors sold for general purposes, as it was felt that in most cases these were sold under unknown and indefinite conditions of service and that the users of such motors generally expected a greater leeway in capacity than would exist under the 50 deg. C. continuous-rating method. The present commercial standard for open-type general-purpose motors is 40 deg. C. It was also felt that on fully-inclosed-type motors the present commercial standard of 55 deg. C. should be maintained, although this is 5 deg. higher than the maximum permissible limit under the rules of the American Institute of Electrical Engineers.

The following ratings, speeds and shaft diameters were adopted as commercial standards for fractional horse-power motors:

Hp	Rated Speed, R.p.m.	Diameter Shaft Extension, In.
1/8	1700/1750	1/2
1/6	1700/1750	1/2
1/4	1700/1750	5/8
1/3	1700/1750	5/8
1/2	1700/1750	3/4
3/4	1700/1750	3/4

Reports were made showing that considerable progress has been made during the past year in obtaining a working basis of co-operation with other associations such as the American Institute of Electrical Engineers, the National Electric Light Association and the new Associated Manufacturers of Electrical Supplies.

Mr. E. H. Martindale, of the industrial power committee of the American Institute of Electrical Engineers, presented his views at the meeting on the standardization of carbon brushes. This subject was referred to a committee, which is instructed to work out the standardization of carbon brushes along the lines suggested by Mr. Martindale, including a standardization of length, width, thickness and allowable limits.

A sincere vote of thanks was extended to the retiring president, Prof. Francis B. Crocker, for the very valuable work which he had done during the last two years in extending the scope and influence of the Electric Power Club along very broad lines of industrial standardization. The following officers were elected for the coming year: President, Mr. E. R. Harding, of the Holtzer-Cabot Electric Company; vice-president, Mr. James Burke, of the Burke Electric Company, and secretary, Mr. C. H. Roth, of the Roth Brothers Company.

SOUTHWESTERN MEETING AT GALVESTON

Large Attendance of Texas Central-Station Men to Hear Discussions on Public Relations and Welfare Topics

Jitney buses, employees' welfare and boiler-room economies were among the topics of chief interest to delegates at the eleventh annual convention of the Southwestern Electrical & Gas Association held at Galveston, Tex., May 19 to 22. The registered attendance at the convention exceeded 400, and in spite of the fact that business conditions in Texas were unfavorable during the last year, the membership of the association has increased. The association has enrolled at present on the books of its secretary, Mr. H. S. Cooper of Dallas, 232 members. According to rumors afloat in the convention hall, steps are being taken by the executive committee to make the Southwestern association a section of the National Electric Light Association.

President Fisher Urges Effective Publicity

In his address as president of the association, Mr. D. G. Fisher of Dallas said that during the last strenuous year public utilities have been passing through a most critical period, occasioned not so much by changes in the methods of doing business as by the attitude of the general public toward all utilities. Vexing problems arising through the evolution of governmental regulation have also beset the utilities. There is, said President Fisher, a great need for effective publicity. During many years the practice of public service corporations has been to observe silence as to their affairs. There is little cause for wonder that as the result of such practice the public has become imbued with suspicion and distrust.

To overcome this sentiment in Texas no better code of principles could be adopted, declared Mr. Fisher, than those laid down by President Wilson in his address before the midwinter meeting of the American Electric Railway Association:

"Let the public know what you are doing," said Mr. Fisher, in quoting the President, "and let it judge you by your deeds. Give the public full equivalent for the money you receive. Inject into your business a certain kind of conscience, a certain feeling that all are in this work because we are expected to 'make good' according to the standards of the people with whom we live. In short, establish throughout utilities organizations the spirit of service."

Boiler-Room Waste and Economies

Opening the first meeting of the electric-lighting section of the convention, Mr. F. N. Lawton, manager of the Wichita Falls (Tex.) Electric Company, read a paper in which he related his experiences in attempting to reduce plant production costs by eliminating the boiler-room wastes. One of the surest outward indications of efficency of station firing, said Mr. Lawton, is the general appearance of the boiler room. Efficiency or inefficiency is generally indicated, said he, by clean floors and polished brass, on the one hand, and by untidy firing aisles and grimy hand-rails on the other.

Bringing up the subject of lignite firing during the discussion, Mr. F. A. Matthes of Longview stated that he had been using Texas lignite in his plant and had, on account of the low cost of this fuel, been able to effect a saving of 30 per cent in the cost of producing electrical energy. Lignite at Longview is burned in air-tight furnaces supplied with forced draft. The ash pit under each boiler is divided into two sections so that one-half of the fire can be cleaned while the other section of the furnace is in operation. With this arrangement it has been possible to force a 150-hp boiler to produce 185 hp.

Extending Commercial Effort to All Company Departments

Lively interest was evidenced in the success of Mr. Matthes' experiments. Those who took part in the discussion were Messrs. H. S. Cooper of Dallas, C. W. Rodgers of Galveston, G. W. Smith of San Antonio, R. J. Irvine of San Angelo, and W. J. Schwander of Dallas.

Mr. Martin J. Wolf, general sales manager for W. N. Matthews & Brother of St. Louis, in a paper entitled "Modern Commercial Distribution," said the biggest problem in business to-day is men. Because of this fact, difficulties in distribution or merchandising confront our industry perhaps more than others because the electrical field has four natural divisions which unfortunately have not always been in harmony with each other. Naming the utility companies as the foundation of the electrical industry, Mr. Wolf outlined the unselfish duties and the co-operative attitudes which in his opinion manufacturers, supply jobbers and contractors should assume in order to broaden the markets for all things needed by the utility companies and their customers.

Accounting Session

At the May meeting of the executive committee of the association in 1914 a committee on accounting was appointed to outline an accounting system for medium-sized and small utilities. At the meeting of the accounting section the report of this committee was presented by Mr. C. E. Calder, chairman. The report, which covered sixty-nine printed pages, was issued with the idea that it might help the 150 Texas utilities which have annual gross receipts of less than $100,000.

"The Commercialization of Central-Station Organizations" was the title of a paper presented by Mr. Hartwell Jalonick, commercial engineer of the Texas Power & Light Company of Dallas. In his paper Mr. Jalonick pointed out that sales effort should not be confined entirely to the commercial departments of utilities but should be made to permeate the entire organization. Every employee who comes in contact with the public, he said, should endeavor to create the impression that it is the business of the central-station company to render commercial service to all possible patrons residing within reach of the company's lines.

Texas Law Covering Energy Theft Defeated

The report of the committee appointed to secure, if possible, the passage of a law protecting public utilities against dishonest customers showed that the radical character of the proposed law had defeated the movement. The bill as prepared and presented to the Legislature provided that anything found on a consumer's premises which showed an intention to steal energy might constitute prima facie evidence of intent to defraud, and provided further that the person at that time a tenant, or the person having legal access to the premises, was to be judged guilty if discovered with such a device in his possession.

Advertising Influence of Employees

Every employee of every business has a potential advertising value by reason of the fact that he has a direct influence in the identification of the company for which he works, said Mr. F. R. Slater of Dallas, in his paper on the "Advertising Influence of Employees." Very few persons can conceive of any business as a personal entity; nearly always there is a human personality in business which influences the public. This personality or this influence of identification may be the managing head of the concern, or some of his assistants who have come into more direct contact with the public. The actual heads and executives of public service companies meet the public rarely. The "visible" part of the business is made up of the local employees. If these men are courteous, if they show consideration, if they are inclined to observe the customers' rights, the business will gain the public's good will and confidence, and thereby become identified as a concern with which it is desirable to do business.

In the discussion of the paper Mr. H. F. Cameron of Charles Lake, La., suggested that employees of central stations can undoubtedly do more to win the good feeling of the people in the community than any other advertising influence. Mr. Fred Johnson of St. Louis, Mo., remarked that the conduct of a salesman necessarily reflects the policy of the company which he represents. Mr. J. C. Kennedy of Benham, Tex., explained that most of the employees of his company were persons raised in Benham. The fact that they are home people, he said, has a great influence in binding the public to the company. Others who discussed this paper were Messrs. A. H. Warren of Galveston, D. S. Mair of Chicago, and Richard Meriwether and Harry Glass of Dallas, Tex.

Benefit from Association Membership

The paper prepared by Mr. A. V. Wainright, vice-president and general manager of the Abilene (Tex.) Gas & Electric Company, entitled "What the Southwestern Electrical and Gas Association Can Do for Me," was an appeal to the members of the association to do their duty as members of the body and to avail themselves of information procurable at the central office of the association. In the absence of Mr. Wainright, the paper was presented by Mr. F. A. Matthes of Longview.

"Positive and Negative Elements in Trade" was the subject of a paper presented by Mr. Fred Johnson of St. Louis in which the writer called attention to the negative attitude of the buyer which often makes it necessary for the salesman to waste much time in obtaining an audience with his prospective customers. Mr. Johnson appealed to central-station men to co-operate with manufacturers and jobbers by giving sales representatives prompt interviews at the time of their calls.

Charles B. Scott on Safety

In his paper on "Important Factors in Accident Prevention," Mr. Charles B. Scott of Chicago pointed out the fact that 85 per cent of the accidents which occur in the electrical industry are caused by failure of the human element and not because of defective mechanical conditions. There are, said he, more injuries to employees in the electrical industry caused by workmen dropping insulators, pliers or cross-arms from the tops of poles upon fellow workers than occur by accidental contact with live conductors. Even after a company has fitted all its machines with all possible mechanical safeguards, its executives must realize that the fundamental essential in safety work lies in interesting the workman himself in the movement.

Employees' Welfare and Education

Following Mr. Scott's paper, Mr. Richard Meriwether, general superintendent of the Dallas street railway company, presented his paper on "Welfare Work and Education of the Employee." In concluding his paper, Mr. Meriwether said: "Welfare work and educational work are means of breaking down the old barrier of distrust, suspicion and disloyalty which existed between the employee and employer and of substituting for them an understanding of the true relationship and the dependence of one upon the other for their mutual advancement and happiness. The extent of welfare and educational work should be limited only by the financial ability of the company and the wisdom of its officials, guarding always against paternalism but striving continually to advance the happiness and well-being of the

employees, and winning thereby their co-operation and loyalty."

Both the papers on employees' safety, welfare and educational work were received appreciatively, and in the lively discussion which ensued the following spoke: Messrs. David Daly of Houston, A. H. Warren of Galveston, W. A. Sullivan of Freeport, V. W. Berry of Fort Worth, H. S. Cooper of Dallas, and J. S. Cowles of Freeport. The trend of the discussion indicated that the delegates were unanimous in the belief that mutual-benefit associations, as operated by many companies, are breeders of loyalty among employees.

Election of Officers and Entertainment Features

Election of officers for the ensuing year resulted as follows: President, Mr. David Daly of Houston; vice-president, Mr. F. R. Slater of Dallas; second vice-president, Mr. H. C. Morris of Dallas; third vice-president, Mr. D. A. Hegarty of Houston; treasurer, Mr. J. W. Walker of Dallas, and secretary, Mr. H. S. Cooper of Dallas.

A Jovian rejuvenation and banquet, attended by many prominent Jovians, was one of the entertainment features enjoyed by the delegates. Surf-bathing parties on the beach of "the Atlantic City of the South," and the annual banquet of the association given by the courtesy of the commercial members of the association, were among the convention diversions.

Convention of Arkansas Utility Operators

Problems of financing small utility companies, franchise terms, customers' accounts, motor applications, and kindred subjects, occupied the attention of the Arkansas Association of Public Utility Operators at their Little Rock convention May 11 to 13.

In his opening address President C. J. Griffith commented on the "jitney bus" situation, emphasizing the unfairness of taxing the street railways to support pavements on which their competitors operate.

"Financing, Constructing and Operating Public Utilities in Small Towns" was the title of a paper by Mr. H. C. Couch, president of the Arkansas Power Company, Malvern, Ark. Mr. Couch commented on the difficulty experienced at present in interesting financiers in new utility enterprises. He cautioned promotors endeavoring to finance a property against painting it in tints too rosy, thereby making the financier expect too much from his investment. Mr. Couch also emphasized the value of long-term franchises, declaring that it is hard to finance a utility the franchise of which has less than twenty-five years to run. He insisted that it should not be difficult to convince a city council that a long-term franchise is not detrimental to the community's interest, while it is distinctly beneficial in financing the property, and that a city can properly grant a fifty-year franchise, while making contracts for street lighting and fire-hydrant service for shorter periods. Turning to the operation of the small central station, Mr. Couch urged that everyone connected with the company study most seriously the needs of the company's patrons. Each employee, he declared, should always be ready to listen to a complaint and to remove the cause therefor if possible.

Mr. Couch's paper was discussed by Messrs. C. J. Griffith of Little Rock, Byron C. Fowles of Pine Bluff, Minor Q. Woodward of Pine Bluff, E. T. Reynolds of Camden, and C. M. Richards of Hope.

On Wednesday morning Mr. Fred Johnson, Wagner Electric Manufacturing Company, St. Louis, presented a paper pointing out why central-station operators should control the types of motors and accessories used by their customers in order to secure the best operating results. Mr. Johnson cautioned central-station managers against adding to their lines too many underloaded motors, as such practice has a bad effect on the system power-factor. Where the power service is sixty cycles, the customer should also be discouraged from installing very slow-speed motors, as the power-factor and efficiency of such motors are low. Mr. Johnson's paper was discussed by Messrs. C. C. Allbutter of Clarksville, A. E. Main of Mammoth Spring, Minor Q. Woodward of Pine Bluff, A. E. Smith of Little Rock, W. J. O'Brien of Helena, A. R. Taylor of Prescott, and J. F. Christy of Jonesboro.

Relations with Customers

In the general discussion of operating problems which closed the session, Mr. H. C. Couch brought up the topics of methods of reading meters, delivering bills and collecting accounts. Mr. Roy B. Fowles, acting auditor of the Pine Bluff Company, outlined the system used at Pine Bluff, and Mr. Byron C. Fowles, manager of the company, stated that the uncollected accounts carried over at the end of the month rarely exceeded $50, and had been even as low as 50 cents.

Mr. A. E. Main of Mammoth Spring, Mr. W. J. Tharp of Little Rock, Mrs. A. B. Stoops of Stuttgart, Mr. A. Patterson of Texarkana, Mr. A. E. Smith of Little Rock, Mr. C. M. Gassaway of Russellville, Mr. J. F. Christy of Jonesboro and Mr. A. R. Taylor of Prescott explained the methods used by their companies in reading meters, delivering bills and collecting accounts.

On Wednesday afternoon Mr. J. J. Dorney, Westinghouse Electric & Manufacturing Company, St. Louis, Mo., read a paper on applications of motors operated by central-station power, pointing out the possibilities for motor loads in the factories, cotton gins, cottonseed mills, rice-irrigating plants and ice factories of Arkansas. Mr. Dorney estimated that there are 1900 active cotton gins in Arkansas, ginning a million bales a year. An up-to-date gin takes from 50 hp to 75 hp, and the average consumption for a 500-lb. bale of cotton, ginned and pressed, is about 15 kw-hr.

On Wednesday the Arkansas Electrical Contractors' Association met with the utility operators, and in the afternoon there was a Jovian rejuvenation. In the evening the electrical supply men tendered a banquet at the Hotel Marion. Nearly 150 were present, and President Griffith acted as toastmaster.

Topics of Plant Operation

On Thursday morning Mr. H. F. McRell, General Electric Company, St. Louis, Mo., spoke on "Voltage Regulation." He was followed by Mr. Andrew Patterson, general superintendent of the Southwestern Gas & Electric Company of Texarkana, who read a paper on "Economic Central-Station Operation and Its Relation to Switchboard Kilowatt-Hour Cost." The author also dealt at length on the formation of scale in boilers and the loss of efficiency thereby.

"Water-Power and Transmission Development in North Central Arkansas" was the subject of a paper by Mr. A. E. Main, in which the interesting development of the Mammoth Spring Electric Light & Power Company, at Mammoth Spring, was described in detail.

The following officers were elected for the year: President, Mr. H. C. Couch, Little Rock; vice-presidents, Messrs. W. L. Woods, Texarkana, and W. J. O'Brien, Helena, and secretary-treasurer, Mr. Roy B. Fowles, Pine Bluff.

The newly elected president appointed the following members of the executive committee: Mr. Andrew Patterson, Texarkana; Mrs. Anna B. Stoops, Stuttgart; Mr. J. F. Christy, Jonesboro; Mr. Byron C. Fowles, Pine Bluff, and Mr. C. J. Griffith, Little Rock.

Miscellaneous News Notes

Boston Edison Company Is Boston's Largest Taxpayer.—The largest tax paid in 1914 in Boston was by the Edison Electric Illuminating Company, the amount being $420,564, representing the assessment on $7,032,200 real estate and $17,000,000 personal property.

Eastern Time Agitation at Toledo.—Following the lead of Detroit, which two weeks ago adopted Eastern standard time, there is at present much newspaper discussion at Toledo, Ohio, concerning the advisability of setting local clocks one hour forward. The local newspapers are inviting their readers to cast ballots on the subject.

Commonwealth Edison Company's 4000 Miles of Conduit.—Data on the equipment of the Commonwealth Edison Company, Chicago, show that at the beginning of the present year the company had in service 20,149,233 duct-ft., or approximately 4000 miles, of conduit. The normal rate of increase is from 1,000,000 to 1,500,000 duct-ft. per year.

Attempt to Prevent Manufacture of Munitions of War.—The case in which Mr. Samuel Pearson, of Scranton, Pa., obtained an order requiring the Allis-Chalmers Company of Milwaukee, Wis., to show cause why it should not be restrained from manufacturing and shipping abroad munitions of war was argued on May 20 before Judge Turner in Milwaukee. Mr. Max Pam, attorney for the company, asked for a stay of the order. He said: "This is entirely a political question and is not one for the courts to decide. Appeal can be made only to the administrative officials, and a court of equity cannot take cognizance of this action." The complainant was a general in the Boer war. He maintains that he has property in Germany which might be affected.

Investigation of Municipal Plant at Fremont, Neb.—Councilman Simon Koeberlin of Fremont, Neb., introduced a resolution before the City Council on May 18 providing for the appointment of experts to make a complete report of the financial condition of the municipal light and water plant. He said that the last published report of the Board of Public Works showed that gross earnings of the plant for the year ended July 31, 1914, were $75,207, operating expenses were $45,077, and net earnings were $30,130. The following, he said, were a few of the items omitted by the board in its calculation of expenses: Interest on $149,000 light and water bonds, $6,955; due to sinking fund, $7,450; interest on $166,100, the amount invested in the plant from sales of bonds, $8,349; depreciation on plant and to finance additions, extensions and replacements, $26,338; park sewer built to accommodate water discharge from turbine engine, $381; lost taxes, $4,335; a total, with the amount stated as operating expenses, of $98,885. After allowance for these expenses Mr. Koeberlin said that the net deficit would be $23,677.

A 20,000-Kw Turbine for Toledo, Ohio.—By Nov. 1 of this year the Toledo Railways & Light Company expects to have a new Westinghouse 20,000-kw, 4000-volt, three-phase, twenty-five-cycle turbine in operation at its Water Street plant. To make room for this large unit much of the present direct-current equipment in the plant will be rearranged and several alternating-current machines, including a 2000-kw frequency changer and sixteen arc-lighting rectifier panels, will be moved to the company's Detroit Avenue station. The latter plant will be remodeled and will be made a switching station on the company's 23,000-volt underground lines, which lead to the factory of the Willys-Overland company. Besides the three 23,000-volt cables which are now laid to the Overland plant, another single and similar three-phase line will be laid from the Water Street plant to the Detroit Avenue station, a distance of about two miles. With the 20,000-kw unit installed, the total generator rating of the Toledo company will be 40,000 kw. The company's engineers now estimate that the December peak for 1915 will reach about 34,000 kw, which is 10,000 kw higher than the peak of 1914. William E. Richards, superintendent of the electrical department of the company, explains that the remarkable increase in the company's load is due in part to the demand created by several large former isolated plants which have adopted central-station drive.

Associations and Societies

West Virginia Utilities Convention.—The first annual meeting of representatives of public utilities of West Virginia will be held at Charleston, June 8 and 9. Mr. W. C. Davison of Charleston is secretary of the new organization.

Northern White Cedar Association.—The midsummer meeting of the Northern White Cedar Association will be held at Beaudette, Minn., June 25 to 29 inclusive. Mr. N. E. Boucher, 743 Lumber Exchange, Minneapolis, Minn., is secretary.

Meeting of Board of Governors of Associated Manufacturers.—It is expected that the next meeting of the board of governors of the Associated Manufacturers of Electrical Supplies will be held at the Hotel Biltmore, New York City, on the evening of Thursday, June 10.

National District Heating Association at Chicago.—As already announced in these columns, the seventh annual convention of the National District Heating Association will be held at the Hotel Sherman, Chicago, June 1, 2 and 3. Mr. D. L. Gaskill of Greenville, Ohio, is secretary.

Railroad Electricians' Club, Chicago.—Mr. C. J. Causland, chief electrician for the Pennsylvania Lines West, has been elected president of the newly organized Railroad Electricians' Club of Chicago. At the meeting of May 24 the topic of ampere-hour-meter control of car-lighting systems was discussed.

Pennsylvania Section, N. E. L. A.—The eighth annual convention of the Pennsylvania Electric Association (State Branch of the National Electric Light Association) will be held at the Bedford Springs Hotel, Bedford Springs, Pa., on Sept. 8, 9 and 10. Mr. H. N. Müller, 435 Sixth Avenue, Pittsburgh, Pa., is secretary-treasurer of the association.

Engineers' Society of Pennsylvania.—Mr. John Liston, of the General Electric Company, gave an illustrated lecture on "The Panama Canal and Its Electrical Equipment" at the final meeting of the season of the Engineers' Society of Pennsylvania, held at Harrisburg, Pa., May 14. Motion pictures were shown illustrating applications of electricity in building the canal.

Ten Years of Evolution in Hydroelectric Units.—At a joint meeting of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, held at Chicago, Ill., on May 24, Mr. E. B. Ellicott and Mr. William B. Jackson of Chicago reviewed developments made in waterwheel construction and design during the last ten years.

Minnesota Contractors to Meet at Duluth.—The summer convention of the Minnesota Electrical Contractors' Association will be held at Duluth, Minn., on June 10. A paper on "Concentric Wiring" will be presented by Messrs. Rider, LaValle and Arnsten. Mr. A. W. Zahn will report on the changes in the Underwriters' rules. Mr. G. M. Jones, of Minneapolis, is secretary of the association.

New York Electrical Society Attendance.—Secretary George H. Guy of the New York Electrical Society stated at a recent meeting that the average attendance at the meetings of the society during this season has been 231. This is among the highest records for the season of the attendance at meetings of the twenty-two organizations with headquarters in the Engineering Societies Building.

Chicago Electric Club—Jovian League.—At its meeting of May 24 the Chicago Jovian League unanimously resolved that the league "cease to exist as a separate organization and that its present members become members of the consolidated organization known as the Electric Club—Jovian League." This action by the Chicago Jovian organization is the final step in the consolidation of the two local electrical luncheon clubs.

Railway Electrical Engineers at Atlantic City.—The semi-annual convention of the Association of Railway Electrical Engineers will be held at the Hotel Denis, Atlantic City, N. J., June 14, during the annual conventions of the American Railway Master Mechanics' Association and the Master Car Builders' Association, which will continue in session from June 9 to 16. Mr. Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, is secretary of the Association of Railway Electrical Engineers.

Iron and Steel Electrical Engineers.—The annual convention of the Association of Iron and Steel Electrical Engineers will be held at the Hotel Statler, Detroit, Mich., Sept. 8, 9, 10 and 11. Mr. W. T. Snyder, McKeesport, Pa., is secretary.

Los Angeles Section, E. V. A.—Mr. Harry W. Harrison has been elected chairman of the Los Angeles Section of the Electric Vehicle Association of America to complete the term of Mr. J. Harry Pieper, of the Southern California Edison Company, who resigned on account of pressure of work. Mr. Harrison is proprietor of the Commercial Electric Garage.

Carnegie Mho Club Becomes A. I. E. E. Branch.—The Mho Club of the Carnegie Institute of Technology, Pittsburgh, Pa., which is composed of electrical students of the School of Applied Science, held a dinner May 20, to celebrate the formation of a local branch of the American Institute of Electrical Engineers, which will take over practically all the technical work of the Mho Club. Mr. J. E. Welsh, chairman of the Pittsburgh Section, A. I. E. E., was toastmaster.

New York Section, E. V. A.—At the monthly meeting of the New York Section of the Electric Vehicle Association of America, May 25, representatives of a number of manufacturers described various types of charging apparatus for electric automobiles. Some of the speakers illustrated their remarks with lantern slides. The following men spoke: Messrs. D. J. Burns of the Ward Leonard Company, J. J. Kline of the Fort Wayne Electric Works of the General Electric Company, G. B. di Moise of the Westinghouse Electric & Manufacturing Company, E. T. Foote of the Cutler-Hammer Manufacturing Company, F. W. Eller of the Electric Products Company, E. D. Pike of the Wagner Electric Manufacturing Company, and E. B. Forslund of the Northwestern Electric Company.

Annual Meeting of Baltimore Section, N. E. L. A.—At the annual meeting of the Baltimore Section of the National Electric Light Association the following officers were elected: President, Major H. S. Barrett; vice-president, Mr. J. S. Cruikshank; secretary, Mr. D. C. Bruce; treasurer, Mr. J. F. Wenchel; executive committee, Messrs. G. H. Albrecht, C. S. Colburn, W. T. Beidler and E. W. Jahn. Cash prizes were awarded to the following, who submitted the best papers in the prize contest: Messrs. J. G. Reese, W. H. Cole, Frank Ruth, O. A. Bethke, Jerome Nixon, T. D. Rose, Thomas King, J. A. Sutton, H. L. Simmons, H. M. Riley, T. J. Kelly, L. F. Turnbull, M. A. Poster, W. H. Hammond and C. F. Filler. At the conclusion of the meeting Mr. F. M. Weller, the retiring president, was presented with a loving cup.

New England N. E. L. A. Section Fall Convention.—The fall convention of the New England Section of the National Electric Light Association will be held at the Mount Kineo House, on Moosehead Lake, Kineo, Maine, Sept. 14 to 17. Although the convention headquarters are about a day's journey from Boston, a large attendance is anticipated. The New England Section now has over 1100 members. Features of the program will be the devotion of an entire day to the subject of large motor-installation business and half a day to the topic of commission regulation, with consideration of electric-vehicle and commercial problems at other sessions. President L. D. Gibbs, of Boston, and about thirty other members of the New England Section will be in attendance at the convention of the national association at San Francisco in June.

Philadelphia Electric Company Section, N. E. L. A.—The work of the Philadelphia Electric Company Section of the National Electric Light Association was brought to a close May 18 with the annual meeting, when reports presented for the year showed an average attendance at section meetings of nearly 500. During the year 116 new members were added to the roll, making the total membership 888. Attendance at the branch meetings has averaged seventy-five. Mr. W. A. LaDue, division superintendent of the Public Service Electric Company of New Jersey, addressed the May 18 meeting on the subject of aerial line construction, illustrating his remarks with moving pictures. The election of officers resulted in the choice of Mr. H. P. Liversidge, superintendent of the company's operating department, as president. Mr. A. L. Atmore was elected secretary.

Public Service Commission News

New York Commissions

Mr. William R. Willcox, formerly chairman of the New York Public Service Commission, First District, appeared recently before the public utilities committee of the constitutional convention to urge that public service commissioners be made constitutional officers and that their terms of office be extended from five to ten years. He said that Governor Whitman is experiencing great difficulty in getting men of proper caliber for the commissions. One reason is the short term and another is the fact that without constitutional protection the places are subject to political control.

Mr. Willcox said that, except as to questions of law, there should be no court review of commission decisions. He would not go so far as to deprive the Legislature, which is the source of the rate-making power, of the right to make rates, though it would be wise for that body to refrain from exercising this right generally. He declared that the excesses in bond and stock issues by public service corporations had much to do with the creation of the commissions and that if the commissions did not have power to regulate security issues there would be no regulation at all.

Mr. John N. Carlisle, formerly a member of the New York Public Service Commission, Second District, said that unless members of the commission were removed from political influences it would be very difficult to get men worth the salaries paid. No governor has been strong enough to resist party demands for the appointment of members to the commissions. Mr. Carlisle expressed the opinion that the salaries of the commissioners should be reduced, so that commissionerships would not be such a lure to politicians. He declared that under present conditions a man who is really worth $15,000 a year is foolish to become a member of the commission, for he cannot tell at what minute he will be removed to make room for a political favorite.

Indiana Commission

The city of Anderson, Ind., has operated a municipal plant for some time, but has had no bonded debt and only a small floating debt. It has been authorized by the commission to issue $50,000 bonds for a stoker, boiler, turbine, switchboard and other apparatus.

The commission has approved a reduced schedule of light and motor-service rates at Fort Wayne for the Fort Wayne & Northern Indiana Traction Company.

Judge D. W. Comstock, of the Wayne Circuit Court, has taken a hand in the situation at Richmond, Ind. The city, which owns a municipal plant, has proceeded under the Indiana utility law, which gives cities the right to institute condemnation proceedings against privately owned plants in certain instances. The action at Richmond, begun before the commission, is directed against the Richmond Light, Heat & Power Company. Judge Comstock has sustained a demurrer by the company to a complaint filed by the city asking for an order to restrain the company from expanding its plant. The city has asked the commission to establish a purchase price, believing the valuation would be set at about $200,000, since the commission's engineers some weeks ago fixed the "present value" of the plant in another case at $161,500. A few days after the city's petition was filed with the commission, the United Gas & Electric Corporation of New York, which controls the Richmond company, announced that $75,000 would be expended at once to increase the output of the plant. City officials held that if this amount was invested the purchase price would be prohibitive. The city officials plan to establish a municipal monopoly to take the place of the competition between the two plants.

Governor Ralston has reappointed Messrs. Charles J. Murphy, of Brookston, and Charles A. Edwards, of Huntington, to membership on the commission for four years from May 1. Mr. Murphy has resigned as a member of the Democratic State committee and chairman of the Tenth Congressional district committee because of a ruling of the Attorney-General on the new primary election law. The Attorney-General holds that this law prohibits persons holding appointive offices from serving as members of a political committee.

Personal

Sir Adam Beck, chairman of the Hydro-Electric Power Commission of Ontario, returned this week from England.

Mr. Roger P. Loud has accepted the position of general manager of the Vinal Haven (Maine) Electric Power Company.

Mr. R. L. Johnson has been appointed chief engineer of the municipal water and light plant of Canton, Ga., as successor to Mr. J. M. West.

Com. F. D. Karns, U. S. N., is the engineering officer at the Mare Island Navy Yard. He takes the place of Lieut. M. G. Cook, who was acting engineer.

Mr. John P. Garner, formerly manager of the Chicago Telephone Company, has been made public service commissioner of Chicago at a salary of $6,000 a year.

Mr. Thomas H. Bibber has been appointed Eastern sales manager for the Adams-Bagnall Electric Company, with headquarters at 30 Church Street, New York City.

Mr. E. H. Waddington has been appointed field manager of the Jovian Order. Mr. Waddington was formerly manager of the St. Louis office of the Cooper Hewitt company.

Mr. Charles E. Fiers has resigned as superintendent of the municipal lighting system of East Grand Forks, Minn., to become partner in an electric-lighting property at Hayfield, Minn.

Mr. F. S. Hartzell, formerly with the General Electric Company in Salt Lake City, Utah, has been appointed supply superintendent of the Electric Company of Missouri at Webster Groves, Mo.

Mr. H. R. Wiles, who for the last three years has been manager of the contract department of the Olean (N. Y.) Electric Light & Power Company, has resigned to take up similar work in Ohio.

Mr. G. M. Schmidt, formerly superintendent of the Electric Company of Missouri's property at Union, Mo., has been appointed district superintendent in charge of the company's properties at Washington, Mo., succeeding Mr. H. D. Hibbeler.

Mr. H. D. Hibbeler, formerly local manager of the property of the Electric Company of Missouri at Washington, Mo., has been transferred to the staff of the Franklin Independent Telephone Company, which is also a North American Company property.

Prof. Alfred Still, of Purdue University, Lafayette, Ind., sailed on the *New York*, May 29, for England, where he will spend the summer months in connection with some special electrical work for Messrs. W. T. Glover & Company, manufacturing electrical engineers, of Manchester.

Mr. Victor H. Todd has been appointed superintendent of electric meters of the Pennsylvania Utilities Company, Easton, Pa., succeeding Mr. Charles F. S. Hance, who recently died of heart failure. Mr. Todd was formerly with the Newark (N. J.) plant of the Westinghouse Electric & Manufacturing Company.

Mr. Herbert L. Harries has become general manager of the Washington-Oregon Corporation, with headquarters at Vancouver, Wash. He was until recently assistant operating superintendent of the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y., having been theretofore assistant general manager of the Louisville (Ky.) Gas & Electric Company, of which his father, Gen. George H. Harries, is president. Like his father, Mr. Harries was enrolled at West Point. He is a first lieutenant in the ordnance department of the District of Columbia militia under presidential appointment.

Mr. L. O. Veser has been appointed electrical superintendent of the Massena (N. Y.) works of the Aluminum Company of America. Mr. Veser is a graduate of Cornell University and until recently was electrical engineer for the Northern Ohio Traction & Light Company, Akron, Ohio. He had for a number of years been associated with the Mahoning & Shenango Railway & Light Company of Youngstown, Ohio, in the capacity of superintendent of construction and chief engineer, and was also with the West Penn Traction Company as assistant superintendent of transmission. Mr. Veser at one time spent several years in the West in hydro-electric work.

Dr. William Marconi, who had been in this country since April 24, sailed for England on the steamship *St. Paul* on May 21. He was called home by the entrance of Italy into the European war. The trial of the suit against the Atlantic Communication Company for alleged infringement of patents, which has been proceeding before Judge Veeder of the United States District Court, was interrupted briefly while Dr. Marconi asked to be excused from further attendance. The court proceeded with the further hearing of other witnesses and then postponed the case until Dr. Marconi returns.

Mr. David Daly, the president-elect of the Southwestern Electric & Gas Association, is general manager of the Houston (Tex.) Electric Company and of the Galveston-Houston Electric Railway Company. Mr. Daly was born in Boston, Mass., Oct. 16, 1878. He was educated in the public schools of that city and afterward entered Harvard. At the age of twenty-two he entered the employ of the Stone & Webster Engineering Corporation, and after serving with that company in Boston in various capacities he was sent by Stone & Webster to Ponce, P. R., as local manager of the Ponce Railway & Light Company. Mr. Daly returned to the United States in May, 1905, and in August of that year was appointed by Stone & Webster to manage the Houston Electric Company, which operates the electric-railway system in the city of Houston. Later, while retaining managership of the Houston Electric Company, Mr. Daly was also made manager of the Galveston-Houston electric interurban line.

Mr. Walter D'Arcy Ryan, whose work in designing the illumination of the Panama-Pacific International Exposition was recently signalized by the award to him of a bronze plaque by President Moore of the Exposition, and by the official designation of "Ryan Night" at the Exposition, has been the originator of many other spectacular illuminating schemes, notable among which have been the "scintillator" illuminations at Niagara Falls and at the Hudson-Fulton celebration, New York, and the flood-lighting of the Singer Tower, New York City. Mr. Ryan was born at Kentville, Nova Scotia, and prepared himself in one of the Canadian institutions for a military career. Later abandoning this intention, he came to the United States about twenty-five years ago, and entered the employ of the General Electric Company at Lynn, Mass. He started in the students' course, but owing to the ability which he displayed in analyzing illuminating problems he was transferred to special investigation work. Later Mr. Ryan was given supervision of a number of men who made up what was then termed the commercial engineering department. This gradually developed into an illuminating engineering laboratory where photometric measurements and investigations were made. About the winter of 1908 Mr. Ryan was transferred to Schenectady, N. Y., and the present illuminating engineering laboratory there, of which he has charge, was established. The interior illumination of the Buffalo General Electric Company's building at Buffalo, N. Y., is a result of Mr. Ryan's work. His conceptions have invariably been daring, novel and appropriate. In addition to planning methods of lighting, Mr. Ryan has invented or developed numerous devices for controlling and adapting lighting units to specific services.

W. D'A. RYAN

Obituary

Stanley Looms, for a number of years manager of the Citizens' Light & Power Company of Oil City, Pa., is dead at the age of fifty-seven years. Mr. Looms was president of the Oil City Audit Company at the time of his death. He is survived by two sons and two daughters.

Corporate and Financial

Bangor (Maine) Power Company.—The company, a subsidiary of the Bangor Railway & Electric Company, has been authorized by the Maine Public Utilities Commission to issue $18,000 of Series B 5 per cent gold bonds for the purpose of reimbursing the treasury for 85 per cent of the actual cost of extensions, betterments and improvements between Jan. 1, 1914, and June 30 of the same year. The bonds are a portion of an issue of $2,500,000, of which $1,252,000 are now outstanding.

Bronx Gas & Electric Company, New York, N. Y.—The New York Public Service Commission, First District, has granted authority to issue $200,000 of 5 per cent first and refunding mortgage bonds. The commission permits the issue of these bonds at 90 because of money market conditions, but stipulates that the discount must be amortized by a regular fixed charge for amortization of 5 per cent, the other 5 per cent to come out of surplus earnings. The proceeds will be used for acquisition of property and for construction, completion, extension and improvement.

Coast Counties Gas & Electric Company, Santa Cruz, Cal.—The California Railroad Commission has granted authority to the company to issue 1000 shares of 6 per cent first preferred stock. The company proposes to sell the stock at not less than 90. The decision allows for a 5 per cent commission if that is found necessary.

Columbus (Ohio) Railway, Power & Light Company.—The Ohio Public Utilities Commission authorized the issue of $1,739,000 of 5 per cent bonds at 80, but refused to permit their hypothecation at a less price pending sale. The company asked to issue $1,800,000 bonds and to use them as collateral at 66 2/3 pending their sale. While $1,187,000 of the bonds will be used for payment of outstanding notes, the commission declined to authorize the issue of bonds for this specific purpose. The proceeds of part of the bonds, under the commission's order, will be used to pay for $951,244 of improvements made from Nov. 1, 1913, to March 31, 1915. The commission also found that the present working capital of $500,000 is insufficient and directed that the proceeds of $300,000 bonds be used to enlarge working capital. The remaining $250,000 bonds are to be used to pay part of the cost of improvements for 1915. The statement of the company filed with the commission showed that $431,220 had been authorized for this purpose.

Dayton (Ohio) Power & Light Company.—The Ohio Public Utilities Commission has authorized the issue of $172,600 bonds and $483,425 preferred stock. Of the proceeds $300,000 is for betterments and the remainder for the purchase of the Miami Light, Heat & Power Company of Piqua.

Detroit (Mich.) Edison Company.—A special meeting of stockholders is called for June 8 to authorize a mortgage on all of the properties and franchises to secure an issue of $75,000,000 bonds, which shall be sold from time to time, as advisable. The earnings for the twelve months ended April 30, 1915, show an increase over the previous year of 16.9 per cent in gross revenue and 30.9 per cent in net revenue. Mr. Alex Dow, the president, says: "To enable the company to meet the demands of this increasing business it must each year make large expenditures in extending and enlarging its generating plant and transmission system, and for this purpose additional capital must be provided from time to time in addition to the amount of cash devoted to this purpose out of surplus earnings. All of the first mortgage bonds of this company having been sold some time ago, and all of the authorized convertible debentures having also been disposed of, the company has no way at the present time of providing this additional capital except by an issue of stock and the sale of the same to its stockholders. While this way of raising funds for the capital requirements of the company has been resorted to in the past and will be used again, the board of directors believes that the company should not be obliged to rely upon this source alone to provide it with funds as required. It is felt that if a new mortgage bond issue be authorized, the company will be able then to provide for its requirements from time to time either by the sale of bonds or by the sale of stock, or both, as conditions may justify. The directors, therefore, recommend that they be authorized to issue refunding mortgage bonds (1) to provide for the retirement at or before their maturity of the $10,000,000 outstanding bonds of this company and of the $4,000,000 bonds of its subsidiary, the Eastern Michigan Edison Company, and (2) to provide additional capital as needed, and that they be empowered to sell such bonds from time to time as they deem advisable. This bond issue should be sufficient in authorized amount to cover all possible requirements of the company for many years to come."

Eastern Shore Gas & Electric Company, Wilmington, Del.—Application has been made to the Maryland Public Service Commission for permission to take over the Cambridge (Md.) Gas, Electric Light & Power Company and the Salisbury (Md.) Light, Heat & Power Company. The Salisbury company, whose assets are placed at $195,082, has $100,000 stock, on which no dividend has been paid in five years. The Cambridge company also has $100,000 stock, with assets stated at $237,790, and it has not paid any dividends in five years; it has also $100,000 bonds. The purchase price of the Salisbury company is not to exceed $210 a share, and that of the Cambridge company $190 a share. The Eastern Shore company is a Delaware corporation organized for the purpose of centralizing operations of a number of electric light and power companies in Delaware and Maryland. Its capital stock is $750,000, of which 1500 shares are preferred and the remainder common shares.

Federal Light & Traction Company, New York, N. Y.—Directors have decided that under existing conditions payment of the regular quarterly dividend of 1.5 per cent on the preferred stock should be deferred. It was stated that while the company has $200,000 cash on hand, without floating debt except a small secured loan for the payment of which provision has been made, and while all financial requirements, including interest, sinking fund, dividends on underlying stock and construction program for the current year, are provided for, the directors thought that it would not be well to disturb this financial position by taking any part of these funds for the payment of preferred dividends at this time.

Frederica (Del.) Water, Light & Power Company.—The receiver, Mr. A. B. Magee, has given notice that the property will be sold at public sale on June 8.

Great Western Power Company, San Francisco, Cal.—The California Railroad Commission has rendered a decision under the terms of which the Great Western Power Company is given authority to purchase the properties of the United Light & Power Company, which operates electric and steam plants in the down-town sections of San Francisco and Oakland. The Great Western company has formed a new corporation, called the Consolidated Electric Company, which is to hold the properties now owned by the United company, the stock to be owned by the Great Western company. The representatives of the Great Western company and of the United company claimed before the commission that the value of the properties of the United company which it is proposed to transfer to the Consolidated company was $1,972,000. They asked that the Consolidated company be granted authority to issue against the properties its bonds in the sum of $2,593,000. In addition, the Great Western company pledged itself to guarantee the bonds of the Consolidated company. The commission held that it would ordinarily be improper to authorize a corporation with assets of $1,972,000 to issue bonds in such an amount as $2,593,000; but owing to the guarantee of the Great Western company, the commission took the view that those bonds might be authorized if the Great Western company should make its guarantee in good faith and if it should provide a sinking fund which would in due time retire enough bonds to restore the proper relation between the value of the properties and the amount of bonds outstanding. Under the terms of the application as presented to the commission, the Great Western company has obligated itself to purchase back within three years $400,000 of the bonds of the Consolidated company. The commission finds that this $400,000 of bonds should constitute the beginning of a sinking fund. It finds further that provision should be made for the retirement, after five years from date, annually, of 1 per cent of the bonds outstanding. In this way, says the commission, the relationship between the value of the prop-

erty and the outstanding bonds will gradually be brought to a proper basis. In this proceeding the Consolidated company also asked the commission to approve a contract for the sale of energy to the San Francisco-Oakland Terminal Railways. The decision states that the San Francisco-Oakland Terminal Railways has not subscribed to the contract, and that it would be idle for the commission to approve such a contract to which both parties had not yet subscribed. Under the terms of the plan, as presented in the application, it is provided that the bonds which the Consolidated company shall issue in the sum of $2,593,000 in order to acquire the properties of the United company shall be divided among the creditors of the United company as follows: The bondholders of the United company (of California), owning $534,000 of bonds, will receive bonds of Consolidated company par for par. The holders of the collateral-trust notes of the United company (of New Jersey), owning $1,618,000 of notes, will be paid on a 90 per cent basis in Consolidated company bonds. The unsecured creditors of United company (of California and New Jersey), whose claims amount to $355,000, will receive 66⅔ per cent of their holdings, 10 per cent of which will be paid in cash and the balance in bonds of Consolidated company. Bonds amounting to $243,000 will be reserved to retire outstanding bonds of the Consumers' Light & Power Company and the Central Oakland Light & Power Company, which are subsidiaries of United company (of California); $71,000 of bonds of Consolidated company will go to Great Western company, and $72,000 of bonds will be used to rehabilitate the properties of United company after they have been acquired.

Ohio Gas & Electric Company, Cincinnati, Ohio.—The company applied recently to the Ohio Public Utilities Commission for permission to take over the following plants at the prices stated: Middletown Gas & Electric Company, $1,075,703; Franklin Electric Light Company, $87,017; Leetonia Electric Company, $46,817, and New Lisbon Gas Company, $58,763. Other companies will also be acquired. The company has applied for authority to issue $700,000 of thirty-year 6 per cent bonds at 85, $200,000 of ten-year 6 per cent debentures at 80, and $795,000 common stock at 70, the proceeds to take care of the $1,268,300 purchase price for the above properties and of $42,500 to be expended for additions to the Middletown plant.

San Joaquin Light & Power Corporation, Fresno, Cal.—The California Railroad Commission has issued an order authorizing the company to refund $317,260 notes.

Southern California Edison Company, Los Angeles, Cal.—The California Railroad Commission has issued a supplemental order approving the agreement between the company and the Los Angeles Trust and Savings Bank, trustee, providing for the issue of $5,000,000 of five-year 7 per cent debentures. Approval of the commission was given for the issue and sale of $2,500,000 of these debentures now.

Tulare County Power Company, Lindsay, Cal.—At the recent meeting of stockholders the offer made by the Mount Whitney Power & Electric Company of Visalia, Cal., to purchase the plant and system was refused. Mr. Patrick M. Longdon, representing the Mount Whitney company, made an offer of $550,000, which, with certain allowances, brought the total offer close to $600,000. It was figured out that the total liabilities of the Tulare company were approximately $230,000. Figures were quoted giving the actual valuation of the properties as between $422,000 and $472,000. During the discussion it developed that the plan of sale was for holders of preferred stock of the Tulare company to receive $120 per share and holders of common stock to receive nothing because they had received service without cost. Holders of the common stock, however, passed an almost unanimous vote against the proposal to sell. It is understood that nearly all consumers are holders of common stock. Liggitt, Hitchborn & Company, brokers for the stockholders, then offered to loan the company $300,000. It was reported that a plan will be suggested to apply to the California Railroad Commission for approval of the issue of $1,000,000 additional stock, $300,000 of which is to be taken up immediately, $200,000 within the next few months, and the remainder as needed. It was also reported that an official of the company had stated that application would be made for approval of a bond issue of at least $200,000.

Manufacturing and Industrial

The E. W. Bliss Company, Brooklyn, N. Y., has opened an office at Detroit, Mich. The office is in Room 2011, Dime Bank Building.

The C & C Electric & Manufacturing Company, Garwood, N. J., has moved its Chicago office to 911 First National Bank Building, Chicago, Ill.

The Albert & J. M. Anderson Manufacturing Company, 289 A Street, Boston, Mass., has opened an office in San Francisco, which will be in charge of Mr. B. J. Durham, who has been connected with the Chicago and Boston offices of the company. The office will be at 613 Postal Telegraph Building.

Linemen's Equipment.—Mr. R. L. Thayer, formerly Chicago representative for the Oshkosh (Wis.) Manufacturing Company, is now Chicago representative of the Wood Shovel & Tool Company of Piqua, Ohio, maker of linemen's equipment. Mr. Thayer has offices at 906 Webster Building, 327 South La Salle Street, Chicago.

The Electrical Machinery Sales Company of Chicago, Ill., representing the Peerless Electric Company of Warren, Ohio, and the Union Electric Company of Milwaukee, Wis., has moved its offices from 53 West Jackson Boulevard to 836 Webster Building, at Van Buren and La Salle Streets. Mr. J. M. Johnson is president of the company.

The Sibley-Pitman Electric Corporation, 19 West Thirty-sixth Street, New York, has taken over the business and assets of Sibley & Pitman, of New York. Mr. C. C. Sibley is president, Mr. G. D. Pitman vice-president, and Mr. H. Q. Foreman secretary and treasurer. The board of directors is composed of Messrs. C. C. Sibley, W. M. Deming, H. Q. Foreman, E. B. Latham and G. D. Pitman. Mr. E. B. Latham is chairman of the board.

Arrow Electric Company's Annual Salesmen's Conference.—A salesmen's conference and convention was held May 12-14 by the eighteen managers of sales territories in the United States for the Arrow Electric Company, Hartford, Conn. The conference discussions covered sales methods, competitive selling of electrical supply goods, shop topics, advice on selling points, territorial difficulties, manufacturers' problems, and the question of South American trade. On May 12 the annual banquet was held.

Westinghouse Lamp Company, New Orleans Office.—Mr. William E. Copeland, formerly of the sales engineering department of the Metropolitan Engineering Company of New York, has been appointed manager of the Westinghouse Lamp Company's office at New Orleans, La. Prior to his connection with the Metropolitan company Mr. Copeland was for several years employed in the same capacity for the Roller-Smith Company, also of New York, and was at one time secretary of the Diamond Electric Sales Company. Mr. Copeland had also completed a special course in illumination in the engineering department of the National Electric Lamp Works at Cleveland.

The McIntosh & Seymour Corporation, Auburn, N. Y., has appointed Mr. A. G. Wright, 209 Slaughter Building, Dallas, Tex., as its agent in the Texas and Oklahoma territory. This appointment excludes that portion of Texas west of a line drawn north and south through Del Rio. Mr. Wright was formerly sales engineer for the H. W. Graber Machinery Company and was at one time agent in the Southwest for the American Diesel Engine company. Subsequently he was Western sales manager for a firm handling boilers, steam engines, generators, etc., and in 1912 he became vice-president of a company which acted as jobbers of machinery and mill supplies.

Patent and Copyright Law.—Mr. J. T. McNaier, for a number of years with the H. W. Johns-Manville Company, has become associated with the law firm of Briesen & Knauth, 25 Broad Street, New York City. Mr. McNaier has been giving considerable study to patent applications and patent litigation work for several years. He supplemented his engineering studies at Lehigh University with a law course, securing the degree of LL.B. from the New York Law School and later passing the New York State examination for admission to the bar. Subsequently he took up a special course of study in the law school of New York University in copyright, trade-mark and patent law.

Turbines for Hydroelectric Installations.—An order has been received by the Trump Manufacturing Company, Springfield, Ohio, for a turbine unit for the filtration plant of the Cincinnati (Ohio) water-works. This is the third unit to be added to the plant. The turbines are provided with an internal by-pass, so that a constant flow of water passes through the turbine, whether it is in operation or is standing still. The Trump company has also recently received orders for two horizontal 500-hp turbines for operation under a 40-ft. head for the Manchester (N. H.) Water Board, which are to be directly connected to General Electric generators. The United States Reclamation Service has also placed an order for a turbine to be operated under a varying head from 150 ft. to 190 ft. The wheel will be mounted in a spiral casing and will be used in connection with the Elephant Butte storage dam in New Mexico. The turbine will be the eighth unit built by the Trump company within a year for use by the government. The Trump Manufacturing Company also reports receipt of a number of orders from foreign countries, among them being one for a horizontal unit for hydroelectric development in Cuba.

The Electrical Industry in France During War Time.—In a review of trade conditions in France, Consul-General A. M. Thackara, stationed at Paris, comments on the noticeable increase in the manufacture of metal-filament lamps in France during the early part of 1914, so that, notwithstanding the falling off during the second half of the year, the total annual production was about 30 per cent in excess of that of 1913. Owing to keen competition, the lamp prices during the first six months of 1914 were very low, but toward the end of the year, in consequence of the decreased production caused by the scarcity of labor and material, prices were advanced, the increase ranging from 20 per cent to 30 per cent. Mr. Thackara reports that there has been a large demand for motors employed in steel work, and that many of the companies, taking advantage of the slackness of trade, have re-equipped and modernized their plants. As with lamps, the scarcity of material and labor and the suppression of important competition has resulted in raising the prices to a better level. Mr. Thackara also spoke of the increasing use of high-efficiency incandescent lamps of small ratings. Water sterilization by the violet rays produced by mercury-vapor quartz lamps is being successfully used for army field sterilizing outfits and also in military hospitals. Mr. Thackara predicts that the hydroelectric developments which have temporarily been brought to a standstill owing to the war will, after the hostilities are terminated, be taken up with renewed activity, and in this branch of the industry there should be a good market for machinery, the greater part of which was previously imported from Germany. Most of the factories in France that were heretofore employed in the manufacture of electrical apparatus are now being used for the manufacture of ammunition, etc., for the army. There is, therefore, now a good opportunity for the importation of all classes of electrical goods into France, especially of electric motors of ratings up to 50 hp.

NEW YORK METAL MARKET PRICES

	May 18 — Selling Price Bid	May 18 — Selling Price Asked	May 25 — Selling Price Bid	May 25 — Selling Price Asked
Copper	£ s d		£ s d	
London, standard spot*	77 10 0		76 0 0	
Prime Lake	18.75 to 19.00		18.50 to 18.75	
Electrolytic	18.50 to 18.75		18.37½ to 18.62½	
Casting	17.25 to 17.50		17.00 to 17.12½	
Copper wire base	20.00		20.00	
Lead	4.20		4.30	
Nickel	45.00 to 48.00		45.00 to 48.00	
Sheet zinc, f.o.b. smelter	18.50		19.50	
Spelter	15.25 to 15.50†		18.75 to 19.25†	
Straits tin	38.50		38.00	
Aluminum, 98 to 99 per cent.	21.50 to 22.50		25.00 to 26.00	

*OLD METALS

Heavy copper and wire	17.25	17.25
Brass, heavy	11.25	11.25
Brass, light	9.25	9.25
Lead, heavy	3.95	3.95
Zinc, scrap	10.50	12.00

*COPPER EXPORTS

Total tons to May 25	28,425

*From daily transactions on the New York Metal Exchange.
†Nominal.

New Incorporations

The Farmers' Light & Power Company, of Colton, S. D., has been incorporated with a capital stock of $10,000 by C. W. Peterson, A. S. Peterson, of Colton, and H. A. Ustrud, of Sioux Falls.

The Union Bridge Electric Manufacturing Company, of Union Bridge, Md., has been granted a charter for the purpose of taking over the electric plant of E. A. C. Buckey in Union Bridge. The company will also install an ice plant. The officers are: Clarence E. Easterday, of Hagerstown, president; Lewis H. Needy, of Boonsboro, vice-president; Leon R. Yourtee, of Hagerstown, secretary, and Orrville E. Shiffler, of Hagerstown, treasurer.

New Industrial Companies

The Gas Engine & Electric Company, of Charleston, S. C., has been chartered with a capital stock of $6,000. The officers are H. Stevens White, president, and Arthur D. Wall, secretary and treasurer.

The Owl Electric Sign Company, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Harry Lanzer, William and Henry Fantel, 600 West 186th Street, New York, N. Y. The company proposes to manufacture fixtures, novelties, etc.

The Jenney Electric Company, of Brockton, Mass., has been incorporated with a capital stock of $3,000 to manufacture electric motors. The directors are: Lester S. Howard, president and treasurer; A. E. Jenney, of Middleboro, and G. W. Scureman, of Marion. The company has opened a plant at 1132 Montello Street, Brockton.

Trade Publications

Household Appliances.—The General Electric Company, Schenectady, N. Y., has issued a folder which describes and illustrates a number of electric appliances for the home.

Return-Call Buzzer and Push-Button.—The Holtzer-Cabot Electric Company, Boston, Mass., is sending out a card which contains information on its return-call buzzer and push-button.

Electric Instruments.—Bulletin No. 12, issued by the Hickok Electrical Instrument Company, Cleveland, Ohio, describes direct-current and alternating-current horizontal edgewise instruments.

Electric Heating Appliances.—The Simplex Conduits, Ltd., 113 Charing Cross Roads, London, W. C., England, has issued a catalog which contains information on various types of heating appliances.

Stationary Vacuum Cleaner.—A motor-driven stationary vacuum cleaner for dwelling houses is described and illustrated in a folder recently issued by the Spencer Turbine Cleaner Company, Hartford, Conn.

Terminal Blocks.—The Colonial Sign & Insulator Company, Akron, Ohio, for which Verne W. Shear & Company, Akron, Ohio, are selling agents, has issued a bulletin which describes and illustrates its lamp-post terminal blocks and its all-porcelain pot-heads.

Electrical Apparatus.—The Burke Electric Company, Erie, Pa., has prepared Bulletin No. 111 on a direct-current speed-change system, Bulletin No. 112 on 110/220-volt balancing transformers, Bulletin No. 114 on polyphase induction motors, and Bulletin No. 116 on an alternating-current speed-change system.

Ignition and Lighting Batteries.—The Electric Storage Battery Company, Philadelphia, Pa., has prepared a third edition of Catalog Section LI, which describes its types LX, SX and S "Exide" batteries for lighting and ignition service. Bulletin No. 149 issued by the company describes batteries for marine wireless service.

Storage Batteries for Marine and Wireless Service.—The Edison Storage Battery Company, 1219 Lakeside Avenue, Orange, N. J., has issued Bulletin 1073, which is an illustrated catalog containing information on storage batteries for marine service. The company has also prepared an attractively illustrated book on storage batteries for wireless equipment.

Construction News

New England

MILFORD, N. H.—The Milford Lt. & Pwr. Co. has entered into a contract with the Connecticut River Pwr. Co., of Brattleboro, Vt., to erect a high-tension transmission line from Townsend, tapping the Connecticut line there. The line will run through Brookline and Pepperill, a distance of 13 miles.

RUTLAND, VT.—Plans for the improvements to the State House of Correction have been prepared which provide for the installation of a new electric generator to supply electricity to operate fans and a new lighting system in the cells.

BOSTON, MASS.—Bids will be received at the office of the fire commissioner, Bristol Street, Boston, until June 2 for furnishing to the fire alarm branch of the Fire Department rubber-insulated, lead-covered cable as follows: 8453 ft. of 20-conductor, 5046 ft. of 19-conductor, 23,733 ft. of 15-conductor, 12,410 ft. of 10-conductor, 9446 ft. of 6-conductor, and 4162 ft. of 4-conductor cable, in accordance with specifications which may be obtained at the office of the superintendent of fire alarms, Fire Department Headquarters, Bristol Street. John Grady is fire commissioner.

MILFORD, MASS.—The Milford El. Lt. & Pwr. Co. has submitted a proposal to the overseers of the town farm offering to extend its transmission lines to the town farm, a distance of 2 miles.

READING, MASS.—Bids will be received by the Municipal Light Board, Reading, until June 5 for furnishing certain materials and labor for construction of extensions to its present distribution system, plans and specifications for which may be obtained at the office of the board.

WORCESTER, MASS.—The Worcester El. Lt. Co. has decided to build an extension to its Webster Street power plant, to cost about $160,000. The plans provide for a one-story building, 104 ft. by 80 ft., and a brick chimney 175 ft. high. Sufficient space is allowed for eight boilers; at present two will be installed with a rating of 1050 hp each, each equipped with two sets of mechanical stokers; also a hot-water heater. As yet, it is understood, no contracts have been awarded.

PAWTUCKET, R. I.—The New England Pwr. Co., 50 Congress Street, Boston, Mass., has closed a large contract with the Jencks Spinning Co., of Pawtucket, to supply electricity to operate a large part of the Jencks company's present plant and all additions.

PROVIDENCE, R. I.—The Narragansett El. Lt. Co., under its Providence contract with the New England Pwr. Co., 50 Congress Street, Boston, Mass., has closed a large contract with the Brown & Sharpe Mfg. Co. to supply energy to operate the shops of the latter company.

Middle Atlantic

ELMIRA, N. Y.—The Elmira Wtr., Lt. & R. R. Co. has applied to the Public Service Commission for permission to erect transmission lines to and a distributing system in the town of Chemung.

HENDERSON, N. Y.—The Henderson Lt. & Pwr. Co. has contracted with the Salmon River Pwr. Co., of Orwell, to furnish electricity in Henderson, Henderson Harbor and vicinity. The Henderson company will extend its transmission lines through the towns of Richland, Sandy Creek, Ellisburgh and Henderson to supply electricity in that section.

NEW YORK, N. Y.—Bids will be received by Marcus M. Marks, borough president, Room 2023, Municipal Building, New York, until June 4 for furnishing and installing an electric and gas-lighting system in the building at 146 Grand Street, borough of Manhattan. Bids will also be received at the same time and place for the installation of an electric elevator in the above building. Blank forms, specifications and plans may be obtained at the office of the auditor, offices of the commissioner of public works, Room 2141, Municipal Building.

OGDENSBURG, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 10 for conduits and wiring in the United States public building at Ogdensburg. For details see proposal columns.

RENSSELAER, N. Y.—A committee has been appointed by the Board of Trade to request the Council to replace the present street-lighting system with type of lamp used in Hudson. The Albany Southern R. R. Co., of Hudson, furnishes the street-lighting service here.

ROCHESTER, N. Y.—Application for a permit to erect a one-story power house at 904 Exchange Street, to cost about $4,000, has been filed by the Vacuum Oil Works.

TROY, N. Y.—The Board of County Supervisors has directed the building and supply committee to advertise for bids for installing an electric-light plant at the county house to take the place of the present gas-lighting system.

LEWISTON, PA.—The Borough Council, it is reported, has decided to accept the proposal submitted by the Penn Central Lt. & Pwr. Co., of Altoona, for street-lighting for a period of ten years, under which the company offers to furnish 400-cp lamps at $43 each per year and lamps of 150 cp at $12.20 per year, both to be the new nitrogen tungsten lamps.

ST. CLAIR, PA.—The contract for improvements to the municipal electric-lighting plant has been awarded to the Hazleton Machinery & Supply Co., of Hazleton. J. H. Hughes is superintendent.

HAMBURG, N. J.—The Bethlehem Steel Co. is planning to install a new electric drilling equipment in connection with plant extensions at its limestone properties in McAfee.

NEWARK, N. J.—The Central Dyestuff & Chemical Co. is contemplating the construction of a new power plant in connection with its manufacturing plant on Plum Lane Point. M. N. Shoemaker is engineer.

PERTH AMBOY, N. J.—The Board of Aldermen has awarded contract for construction of a municipal electric-lighting plant to the Watson-Flagg Engineering Co., 27 Thames Street, New York, N. Y., at $122,082. The work includes the erection of building, furnishing and installing electrical and engine equipment and underground fuel tanks. Runyon & Cary, 845 Broad Street, Newark, are consulting engineers.

PLAINFIELD, N. J.—Plans are being prepared by John G. Brown, architect, Witherspoon Building, Philadelphia, Pa., for an addition to the plant of the International Motor Co., manufacturer of machinery and Sauer trucks, for an addition to its plant, 116 ft. by 120 ft., one story, and engine room, 30 ft. by 60 ft., one story high.

WOODBRIDGE, N. J.—Bids will be received by the township committee until June 7 for lighting the streets of Districts No. 1 and No. 2 for a period of one year.

FROSTBURG, MD.—The Edison El. Illg. Co., of Cumberland, has closed a contract with the Hagerstown & Frederick Ry. Co., of Hagerstown, to supply electricity to operate the electric system in Frostburg.

KENOVA, W. VA.—The Consol. Lt., Ht. & Pwr. Co., it is reported, is contemplating doubling the output of its power plant in Kenova. The equipment will include an 8000-hp turbine and two Babcock & Wilcox boilers.

SEEBERT, W. VA.—Work has begun on the construction of an electric-light plant in Seebert by A. E. Huddleston, who was recently granted franchises in this town and Hillsboro to furnish electricity. Transmission lines will be erected from Seebert to Hillsboro and Millpoint.

LYNCHBURG, VA. — The Lynchburg Trac. & Lt. Co., we are informed, does not contemplate improvements and extensions to its system, as reported in the issue of May 8.

ANACOSTIA, D. C.—Bids will be received by the Secretary of the Interior, Department of the Interior, Washington, D. C., until June 7 for furnishing stokers, coal and ash-handling machinery and other appliances for power house of the Government Hospital for the Insane, Anacostia, in accordance with plans and specifications, copies of which may be obtained upon application to the chief clerk of the department.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 13 for construction of building for the Interior Department offices at Washington, D. C., in accordance with plans and specifications, copies of which may be obtained at the above office upon deposit of $250, to be refunded upon return of same. The plans provide for a building approximately 680,000 sq. ft. (400 ft. by 400 ft., seven stories and basement). Bids may be submitted as follows: (1) For construction, including mechanical equipment, except elevators; (2) construction, except the mechanical equipment and elevators; (3) mechanical equipment only, except elevators; (4) for elevators.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Foreign and Domestic Commerce in the Commerce Reports as follows: No. 16,754—An American consular officer in Switzerland reports that an agent in his district desires to communicate with American manufacturers and exporters of resistance wires or coils and resistance straps or strips to be used in the manufacture of electrical transformers and other electrical machinery. No. 16,775—An importer in Cuba desires catalogs and price lists of fancy lamps, lamp shields and chandeliers. No. 16,776—A New York exporter has received an inquiry from an English firm requesting quotations, etc., on enameled iron shades, 6 to 18 in. in diameter; also for white, and white and green, opal-glass shades, 6 to 18 in. in diameter. No. 16,777—A European mechanical and electrical engineer who is now in United States desires to form commercial relations with manufacturers of machinery and electrical goods with a view to representing them in European countries. No. 16,780—A firm of Swiss importers desires to receive catalogs and price lists from manufacturers of electrical fittings, etc., hardware, household articles, etc. No. 16,789—The manager of an export and import association in this country reports that it is in receipt of a letter from a firm in China which desires to establish commercial relations with American manufacturers and exporters of central heating systems, sanitary equipment and supplies, and electrical goods, such as fans, cells, bells, wiring, lamps, motors, meters, switches, lamp shades, etc. No. 16,790—An American consular officer in Spain reports that a business man in his district desires to establish a commission business for the purpose of handling American-made machinery, electrical goods, copper, iron and steel manufactures, parts for the construction of wagons and street cars, lubricating oils, etc. No. 16,816—A firm in the United States informs the Bureau of Foreign and Domestic Commerce that its London office has cabled the name and address of a firm in England which desires to secure an agency for the sale of American wire and cables. No. 16,818—An American consular officer in Russia transmits the name of a business man in his district who desires to form commercial relations with American manufacturers and exporters of electrical supplies, such as bulbs, chandeliers, wiring, etc. Quotations and descriptive matter should be sent at once. No. 16,821—An American consular officer in Russia transmits the name of a commission merchant in his district who desires to establish commercial relations with American manufacturers and exporters of electric lamps, meters, etc., centrifugal and electrically operated pumps, etc. Correspondence may be in English. Further information may be obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its branches.

North Central

ALBION, MICH.—The Village Board is reported to have entered into an agreement with the Commonwealth Pwr. Co., of Jackson, to supply energy to operate the municipal electric-lighting system. The company will extend its line from Albion to Springport.

DETROIT, MICH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 22 for conduits and wiring in the United States public building in Detroit. For details see proposal columns.

CANTON, OHIO—The Canton El. Co., it is reported, has purchased ground on which it will erect an addition to its power station. Improvements involving an expenditure of about $250,000 have been authorized by the company.

CINCINNATI, OHIO—Plans are being considered by City Electrician Kliene for replacing gas lamps now in use with electric lamps in most of the alleys in the city. Steps are being taken to replace the gas lamps in College Hill, Hartwell, Pleasant Ridge, Oakley, Evanston, Kennedy Heights, Clifton, Avondale and Mount Airy with electric lamps. It is also proposed to erect a number of electric lamps in the Lower River road as soon as the dispute between the Traction company and the Big Four Railroad company is settled.

MANSFIELD, OHIO—The City Board of Control has awarded the Mansfield Ry., Lt. & Pwr. Co. a ten-year contract for lighting the streets of the city, at $18,736 per year. The contract provides for the installation of an ornamental lighting system, consisting of 225 lamps. The awarding of the contract has been enjoined by Conrad Schmidt, a taxpayer. H. Whitford Jones, Citizens' Building, Cleveland, is consulting engineer.

MARIETTA, OHIO—The City Council has rejected the ordinance providing for the purchase of electrical energy from the

Parkersburg, Marietta & Interurban Ry. Co. to operate the municipal electric-lighting system. The Council has authorized the building committee to find a suitable site for a new power station, and the light committee was instructed to secure estimates for equipment for the proposed new municipal electric plant.

SPRINGFIELD, OHIO.—The Board of Trustees of the District Hospital in Springfield contemplate making improvements to the hospital. Considerable electrical work will be done.

STEUBENVILLE, OHIO — Within the next two months the La Belle Iron Works, of Steubenville, expect to install two 1500-kw, three-phase, 25-cycle, 2300-volt generators. James Farrington is superintendent of the electrical department.

YOUNGSTOWN, OHIO.—Contracts, it is reported, will soon be awarded by the Youngstown Sheet & Tube Co. for extensions to its mills, costing about $3,000,000. Electrical power, it is understood, will be used wherever possible.

MOUNT OLIVET, KY.—The Robertson County Lt. & Pwr. Co., recently organized, has taken over the franchise granted to R. H. Therikeld and W. R. Bethel, and will install a power plant in Mount Olivet. The equipment will include a 35-hp to 50-hp oil engine and a 20-kw to 35-kw direct-current generator. From 6000 ft. to 8000 ft. of wire will be required for transmission line. Twenty street lamps have been contracted for by the city. The company is in the market for material for distribution system and also for house wiring and specialties, fixtures, etc. The work will be done by the company. W. R. Bethel is general manager and engineer.

WHITESBURG, KY.—The Town Council has granted Starkey Brothers, of Somerset, a franchise to establish an electric-lighting and power plant in Whitesburg.

BREMEN, IND.—The Town Board has decided to abandon the municipal electric-light plant and has awarded the Hawks El. Co., of Goshen, a contract to supply electricity in Bremen for a period of 10 years. The Hawks company will extend its Goshen-Wakarusa transmission line to Bremen, a distance of about 12 miles.

MILTON, IND.—The Town Board, it is reported, has accepted the proposal submitted by the Lt., Ht. & Pwr. Co., of Connersville, to construct and operate an electric-light plant and water-works system in Milton. The company proposes to erect a pumping station at the river.

CHICAGO, ILL.—Bids will be received by the Union Station Co., 521 West Adams Street, Chicago, Ill., until June 1, for construction of a trunnion bascule bridge over the south branch of the Chicago River at West Monroe Street, and installation of electric equipment, according to plans and specifications on file in the office of Thomas Rood, chief engineer, 521 West Adams Street. Plans and specifications for electrical equipment may be obtained at the office of the engineer upon deposit of $10.

VIROQUA, WIS.—The local electric-light plant, owned by the heirs of the late William F. Lindemann, has been purchased by H. A. Smith, of Monroe, who, it is understood, will make improvements to the system.

HOLDINGFORD, MINN.—A franchise has been granted to V. Herman, of Holdingford, to construct and operate an electric-lighting plant here.

ST. CLOUD, MINN.—Bids will be received by the State Board of Control, State Capitol Building, St. Paul, until June 15 for the entire mechanical equipment, including heating and ventilating, plumbing and electrical construction, of cell house "D," State Reformatory, St. Cloud, in accordance with plans prepared by the Charles L. Pillsbury Co., engineer, Metropolitan Life Building, Minneapolis. Plans may be seen at the office of the superintendent, State Reformatory, St. Cloud, at the office of the State Board of Control, and at the Builders' Exchanges in Minneapolis, St. Paul and Duluth.

ST. PAUL, MINN.—Bids will be received by the State Board of Control, State Capitol, St. Paul, until June 10 for construction of a sanatorium for tuberculosis patients, including general construction, mechanical equipment and deep well, in accordance with plans and specifications prepared by Sund & Dunham, architects, Essex Building, Minneapolis, and Rose & Harris, engineers, of Minneapolis, which may be seen at the office of the architects and also at the Builders' Exchanges in Minneapolis, St. Paul and Duluth.

ALLISON, IA.—The Cedar Valley Lt. & Pwr. Co. has been granted a franchise to supply electricity in Allison. Energy will be supplied from Charles City or Hampton.

GILMAN, IA.—The town of Gilman has granted the Iowa Ry. & Lt. Co., of Cedar Rapids, a franchise to supply electricity in Gilman.

SPENCER, IA.—Bids will be received by E. Taggart, secretary Masonic Temple Association of Spencer, Spencer, until June 17 for construction of Masonic Temple, separate bids to be submitted as follows: General construction; heating; plumbing, sewering and gas fitting; electric wiring. Plans and specifications may be seen at the above office or at the office of John D. Chubb, architect, Chicago, Ill.

HOUSTONIA, MO.—Plans are being considered for the installation of an electric-lighting plant and grain elevator in Houstonia.

KEYTERSVILLE, MO.—The Council has called an election to be held May 31 to vote on the proposal to grant Ray W. Cropper a 20-year franchise to install and operate an electric-lighting plant and also a contract for lighting the streets of the city for a period of ten years.

ST. LOUIS, MO.—A committee has been appointed by the Board of Aldermen to investigate conditions regarding the advisability of establishing a municipal electric-lighting plant in St. Louis.

GOLDEN VALLEY, N. D.—Peter Hess, of Hebron, is planning to install an electric-lighting plant in connection with a flour mill in Golden Valley to supply electricity for lamps and motors in this town.

WAHPETON, N. D. — The Wahpeton-Breakenridge St. Ry. Co., it is reported, is contemplating the installation of a power plant.

VALENTINE, NEB.—The C. H. Cornell Hydro-Electric Co., it is reported, has awarded the contract for construction of a hydroelectric plant to the Steinmeyer-Ryons Construction Co., of Beatrice.

KANSAS CITY, KAN.—The State Board of Administration has awarded the contract for rewiring the State School for the Blind in Kansas City and for wiring the Memorial Hospital in Rosedale, now under construction, to E. A. Brown & Co., of Kansas City. The company was also awarded a contract by the city of Kansas City for the erection of 20 ornamental lamp standards, carrying five-lamp clusters, on James Street, and for 40 ornamental standards, carrying single lamps, on Ninth Street, from Minnesota to Barnett Street.

Southern States

PLYMOUTH, N. C.—At an election held recently the proposal to issue $12,000 in bonds for the installation of a municipal electric-light plant was defeated.

WINNSBORO, S. C.—The Board of Public Works is considering the erection of a 22,000-volt transmission line from the plant of the Parr Shoals Pwr. Co. on Broad River to Winnsboro; also the construction of a substation and to establish a 24-hour service. T. R. Ellison is superintendent.

AUGUSTA, GA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 11 for the installation of an electric passenger elevator in the United States post office and court house at Augusta, Ga., in accordance with drawings and specifications, copies of which may be obtained at the above office.

FORT MEADE, FLA.—Bids will be received by the Board of Trustees, City Hall, Fort Meade, until June 15 for the purchase of $25,500 in bonds, the proceeds to be used for purchase or construction of a municipal electric-lighting plant.

CROSSVILLE, TENN.—The installation of an electric-lighting system in Crossville is under consideration. E. B. Jones and John E. Green are interested.

MEMPHIS, TENN.—The Board of City Commissioners has approved a contract with the Consolidated Gas & El. Co. for furnishing energy to operate the motors in the North Memphis pumping station. Under the terms of the contract the city is to pay the company $25,000 for laying the conduit and erecting the wires from the plant at Myrtle Street and Beale Avenue to Front Street and Exchange Avenue. From there the wires will run overhead.

NASHVILLE, TENN.—The Senate has passed the bill providing for an appropriation of $7,000 to connect the lighting plant at the State penitentiary with the State Capitol Building for the purpose of lighting the Capitol.

BIRMINGHAM, ALA.—The Alabama Pwr. Co., of Birmingham, has closed contracts with the Avondale Mills for furnishing electricity for the Eva Jane and the Central Cotton Mills, at Sylacauga, and the Buck Creek Cotton Mills, at Siluria, the three mills to use about 4000 hp. The factories are now being equipped for electrical operation.

JACKSON, ALA.—The city of Jackson has granted R. V. West and Duel Right a franchise to install and operate an electric-lighting system in Jackson. Work has begun on the installation of the plant.

CLARKSDALE, MISS.—The City Council is reported to be considering submitting to the voters the proposal to issue $150,000 in bonds to enlarge the water-works system and electric-lighting plant and increase the fire department.

BENTON, ARK.—The installation of a street-lighting system in connection with the proposed water-works system is under consideration by the city of Benton. The J. B. McCrary Co., of Atlanta, Ga., is engineer.

SUCCESS, ARK.—The Council has granted a franchise to George Booser, of Corning, Ark., to construct and operate an electric-light plant in Success. Energy for operating the system will be supplied by the Corning plant.

BROMIDE, OKLA.—The Board of Trustees have engaged the Benham Engineering Co., consulting engineers, of Oklahoma City, to make investigations and prepare plans and estimates of cost for the installation of an electric-lighting plant and water-works system. After report is submitted a special election will be called to vote upon a bond issue.

CUERO, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 21 for the construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Cuero. Drawings and specifications may be obtained at the above office or from the custodian of site at Cuero.

DALLAS, TEX.—The Texas Pwr. & Lt. Co., of Dallas, it is understood, will begin serving all of the interurban lines of the Texas Trac. Co. about July 1. A subsidiary company has been organized to take over the power plants of the different interurban lines, and after July 1 they will be operated separately for the purpose of furnishing electricity for lamps and motors in the towns where they are located. The Texas Lt. & Pwr. Co. is changing the transmission line between Dallas and Denison from 19,000 volts, 25 cycles, to 30,000 volts, 60 cycles. Surveys are also being made for right-of-way of a transmission line that will be built from Waco to Taylor by the company. It is also building an addition to the power plant at Palestine in which a 500-hp Diesel engine and a new turbine will be installed. In the North Texas district the company will extend its transmission line from Honey Grove to Ladonia and Commerce.

SAN ANTONIO, TEX.—The commissioners' court of Bexar County has approved the contract of the San Antonio Machine & Supply Co. for the installation of a complete steam-driven power, pumping and electric plant in the Bexar County Aged and Juvenile Home.

SAN BENITO, TEX.—The City Council has adopted plans for a complete street-lighting system which will be installed at once.

Pacific States

BELLINGHAM, WASH.—The Puget Sound Trac., Lt. & Pwr. Co., which operates the local system, is planning to extend its electrical service to Enetie.

FRIDAY HARBOR, WASH.—The Town Council has granted R. D. Berghardt, of Seattle, a franchise to construct and operate an electric-lighting plant in Friday Harbor.

MEYERS FALLS, WASH.—Negotiations have been closed whereby the Stevens County Lt. & Pwr. Co., of Colville, has leased for a period of 99 years the water-power in the Colville River, known as Meyers Falls. The company, it is understood, will make extensive improvements to the property, developing all of the power, which is estimated at 3000 hp. A new concrete dam, 20 ft. high, with a spillway 300 ft. wide, and an entirely new plant will be erected. Electricity will be transmitted to Kettle Falls, Marcus, Meyers Falls, Ward, Colville, Chewelah and to the United Copper and other mines at Chewelah. A high-tension transmission line will be erected between Meyers Falls and Chewelah at once.

OREGON CITY, ORE.—Plans are being considered by the Northwestern El. Co., of Portland, to extend its transmission lines to Oregon City. W. E. Coman, Journal Building, Portland, is vice-president and general manager.

SAN JOSE, CAL.—The proposal to form a public highway lighting district, to be known as the San Martin lighting district, will be submitted to the voters on June 14.

SANDPOINT, IDAHO.—The Trestle Creek Pwr. Co., it is reported, will soon begin work on the construction of a hydroelectric power plant, to develop 680 hp, at Trestle Creek. A 50-ton custom concentrator, to be equipped for electrical operation, will also be installed. Ralph Reinartson, of Spokane, Wash., is interested in the company.

PUEBLO, COL.—Through arrangements made with the Arkansas Valley Ry., Lt. & Pwr. Co., of Pueblo, over 2000 acres of land will be brought under cultivation. By the use of electrically driven pumps the water will be lifted to the land.

Canada

LISTOWEL, ONT.—Work, it is understood, will soon begin on the construction of the new municipal hydroelectric plant. A new distributing and street-lighting system will also be installed.

HULL, QUE.—Bids will be received by H. Bouley, city clerk, Hull, until June 7 for furnishing and installing the following equipment: One 1200-hp waterwheel, one waterwheel governor, one set of double helical gears, one 600-kw, two-phase, 60-cycle electric generator, one centrifugal pump, 5500 imperial gal. per minute, under 280-ft. head, and all necessary appliances, meter gages, piping, switchboard, transformers, starters, etc. Specifications, plans and necessary information may be obtained at the office of J. P. Albert Laforest, city engineer.

QUEBEC, QUE.—The Canadian Pacific Ry. Co., it is reported, is contemplating the construction of a central power station at St. Paul and Henderson Streets, Quebec, to cost approximately $1,000,000. Bids, it is understood, will be asked for construction of building, equipment, etc. H. E. Prindle, New Birke Building, Montreal, is architect.

SHERBROOKE, QUE.—The city of Sherbrooke, it is reported, is contemplating the purchase of electrical supplies, including meters, controllers, etc., amounting to about $27,000. W. E. C. Gatien is city clerk.

Miscellaneous

JUNEAU, ALASKA.—E. P. Kennedy, John Rustgard, H. U. Roedling and others have incorporated under the laws of the State of California and have filed articles of incorporation with the Territorial Secretary for the Spiel River project. The company is negotiating for patents for the establishment of electrochemical factories and power development on the Spiel River.

LUCBAN, P. I.—An electric light and power plant will be installed in Lucban. The proposed plant will cost about $30,000, and machinery and equipment will be purchased in the United States. The project will be financed by Filipino capital. Waterpower of the Pagsipi River will be developed to operate the proposed plant. The equipment will consist of a Pelton water turbine and General Electric alternator, transmission and distributing system.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 18, 1915.

[Prepared by Mitchell & Allyn, 41 Park Row, New York.]

1,139,476. RAPID PHOTOGRAPHIC RECORD OF CURVES OF OSCILLOGRAPHS, RHEOGRAPHS, AND THE LIKE; A. E. Blondel, Paris, France. App. filed Aug. 5, 1913. Special arrangement of mirrors and electric lamps.

1,139,487. ELECTRIC POWER TRANSMISSION POLE; G. D. Cangia, Naples, Italy. App. filed Aug. 27, 1913. Special construction for insulators of the "suspension" type.

1,139,489. INDICATOR; L. Church, Mobridge, S. D. App. filed July 16, 1913. For railway water tanks.

1,139,554. LAMP-CORD REEL; A. MacLean, New York, N. Y. App. filed June 23, 1911. Cord cannot be wound up while lamp is burning.

1,139,623. SYSTEM FOR PRODUCING HIGH-TENSION CURRENTS; C. I. Zimmerman (deceased), Madison, Wis. App. filed Aug. 25, 1909. Current-source translating device; spark burner and condenser in series.

1,139,632. ELECTRICAL RECEIVING APPARATUS; T. B. Booth, Newton Center, Mass. App. filed June 21, 1902. For Hertzian waves.

1,139,668. ELECTRICAL INCANDESCENT LAMP; H. Gerdien and M. Von Pirani, Berlin, Germany. App. filed Feb. 16, 1915. Has a gas filling containing mercury.

1,139,678. MOTOR-CAR-DRIVE SYSTEM; H. F. Hitner, Mount Vernon, Ohio. App. filed Nov. 10, 1913. "Mixed drive," embodying gas engine in conjunction with storage battery and motor-dynamo.

1,139,686. APPARATUS FOR REMOVING TARNISH FROM METALS; H. M. Keyt, Chicago, Ill. App. filed Feb. 14, 1913. Electrolytic; special construction of electrode and container.

1,139,687. SEPARABLE CIRCUIT DEVICE; C. J. Klein, Milwaukee, Wis. App. filed Jan. 11, 1912. Clip construction for two-part attachment plug.

1,139,722. SELECTOR SWITCH; J. N. Reynolds, Greenwich, Conn. App. filed May 10, 1913. Has a pair of rotary-contact operating shafts.

1,139,748. INSULATOR; T. W. Beatty, New Cumberland, W. Va. App. filed Jan. 31, 1912. Two-part porcelain knob for clamping two wires.

1,139,757. THEFT-PREVENTION DEVICE FOR AUTOMOBILES; F. K. Fassett, Dayton, Ohio. App. filed Feb. 6, 1914. Breaks ignition circuit, and alarm is sounded if car is moved.

1,139,759. ELECTRICAL IGNITING DEVICE FOR AUTOMOBILE LAMPS AND THE LIKE; F. N. Fox, Woodstock, Ohio. App. filed June 30, 1914. Sparking device for lighting gas lamps.

1,139,764. JUNCTION BOARD; H. and R. Hodgson and J. Glazbrook, Chicago, Ill. App. filed March 1, 1912. For the fan, center lamp and head and foot lamps of sleeping-car berths.

1,139,778. ELECTROCHEMICAL PROCESS OF TREATING WATERS, LIQUIDS AND SEWAGE; C. P. Landreth, Philadelphia, Pa. App. filed Oct. 12, 1914. Adds material to sewage to insure face alkali therein and passes electric currents therethrough. (Seventy claims.)

1,139,832. TESTING DEVICE FOR ELECTRIC-CURRENT TRANSLATING DEVICES, FUSES, ETC.; H. L. Bartlett, Devils Lake, N. D. App. filed Feb. 11, 1914. Switches and testing devices mounted on portable base.

1,139,839. SAFETY DEVICE; M. J. Bottinelli, Kellogg, Idaho. App. filed April 9, 1914. Detects flaws in the strands of a cable or the lacing of a belt.

1,139,846. RIFLE-RANGE SHOT INDICATOR; E. D. Church, Hartford, Conn. App. filed April 15, 1910. Annunciator indicator.

1,139,859. AUTOMATIC FIRE-ALARM SYSTEM; F. Gottschalk, Stirling, N. J. App. filed Feb. 13, 1914. Thermostatic device operates telephone to give alarm.

1,139,882. ELECTRIC POWER TRANSMISSION SYSTEM; J. R. Markle, Chicago, Ill. App. filed May 13, 1911. Motor-generator; electric drive for automobiles.

1,139,903. SWITCH; H. Pitts, Austin, Tex. App. filed Dec. 24, 1912. For elevator doors.

1,139,906. TELEPHONE-EXCHANGE SYSTEM; L. Polinkowsky, Brussels, Belgium. App. filed Aug. 17, 1914. Calling lines are served by automatic line-finder switches.

1,139,950. INSULATOR BRACKET; F. A. Bowdle, Cerro Gordo, Ill. App. filed Feb. 18, 1913. "Dead-ending bracket" of brazed construction.

1,139,954. SWITCH BOX FOR ELECTRIC TRUCKS; W. C. Carr, Buffalo, N. Y. App. filed April 16, 1913. Inclosed and protected construction.

1,139,956. ELECTROMAGNETIC DEVICE; E. B. Craft, Hackensack, N. J. App. filed March 17, 1910. Water electromagnet operates switching pairs, and another electromagnet controls locking means for retaining said switching parts.

1,139,965. ELECTRIC ARC LAMP; F. W. Gore, New York, N. Y. App. filed May 2, 1906. Attachable to ordinary incandescent lamp socket.

1,139,970. WATER-PURIFYING APPARATUS; H. B. Hartman, Scottdale, Pa. App. filed Aug. 12, 1913. Subjects to electrolytic action and thereafter separates and precipitates impurities.

1,139,972. GEOMETRICALLY PROGRESSIVE CONTROL SYSTEM; C. J. Henschel, Bloomfield, and C. Messick, Hackensack, N. J. App. filed March 24, 1914. Remote control.

1,139,973. ELECTRIC-CABLE TERMINAL; G. L. Herz, Vienna, Austria-Hungary. App. filed March 25, 1913. For spark plugs.

1,139,976. ELECTRIC CONDENSER OR LEYDEN JAR; A. N. Hovland, Christiania, Norway. App. filed May 26, 1911. Of nesting construction.

1,139,994. WARP-STOP MECHANISM; T. J. O'Connell, Ware, Mass. App. filed June 16, 1914. Electromagnetic.

1,140,007. TIME-LIMIT CIRCUIT-BREAKER; H. A. Steen, Milwaukee, Wis. App. filed April 8, 1911. Embodies suction member normally immersed in a liquid.

1,140,011. COMBINED GAS-ENGINE STARTER AND ELECTRIC GENERATOR; J. D. Taylor (deceased), Wilkinsburg, Pa. App. filed May 20, 1913. Motor operating air pump prevents excessive battery charging.

1,140,048. TELEPHONE GUARD; E. O. Loeber, Cleveland, Ohio. App. filed Feb. 5, 1913. Paper mouthpiece cover.

1,140,050. INSULATOR; R. A. Manwaring and J. T. Hessel, New Haven, Conn. App. filed April 23, 1914. Pin type for carrying twin conductor to arc lamp.

1,140,052. COUPLING FOR SECTIONAL RODS; L. L. Mast, West Milton, Ohio. App. filed Feb. 19, 1914. Lightning-rod joint.

1,140,081. BURGLAR OR FIRE ALARM; G. Spitz, Brünn, Austria-Hungary. App. filed April 17, 1912. Sounds alarm when pressure in room varies.

1,140,093. ELECTRIC-RAILWAY SYSTEM; A. Yurow, New York, N. Y. App. filed May 5, 1914. Underground-conduit type.

1,140,094. PLOW FOR ELECTRIC-CONDUIT RAILWAYS; A. Yurow, New York, N. Y. App. filed May 5, 1914. Contact plates can be quickly replaced.

1,140,106. REGULATING SYSTEM; J. Bijur, New York, N. Y. App. filed Jan. 27, 1911. For charging storage batteries.

1,140,120. SELECTIVE CALLING APPARATUS; E. B. Craft, Hackensack, N. J., and G. Brown, Brooklyn, N. Y. App. filed June 30, 1910. For party lines.

1,140,134. INCANDESCENT LAMP; B. E. Eldred, New York, N. Y. App. filed Dec. 30, 1914. Composite leading-in wire having copper sheath.

1,140,150. WIRELESS TRANSMISSION OF ELECTRIC ENERGY; R. C. Galletti, London, Eng. App. filed Feb. 18, 1913. Avoids use of detector.

1,140,151. TELEGRAPHIC INSTRUMENT; J. J. Ghegan, Newark, N. J. App. filed April 25, 1913. Has a vibrator for automatically transmitting certain signals.

1,140,155. MAGNETO GENERATOR; O. H. H. Heins, Edgewater-on-Hudson, N. Y. App. filed March 9, 1909. Has adjustable magnetic shunt.

1,140,165. SIGNALING DEVICE FOR ELEVATORS; H. L. Kilbourne, Memphis, Tenn. App. filed July 2, 1912. Elevator operator may transfer the signal to another elevator traveling in the same direction.

1,140,227. RAILWAY SIGNALING APPARATUS; W. Wright, Kalgoorlie, Western Australia, and L. Langford, South Yarra, Victoria, Australia. App. filed Aug. 1, 1914. Embodies conductor along trackway.

1,140,230. SWITCHBOARD FOR ELECTRIC-CONDUIT RAILWAYS; A. Yurow, New York, N. Y. App. filed May 5, 1914. No break in current at switches.

1,140,247. ELECTRIC COMPENSATOR; G. A. Burnham, Cliftondale, Mass. App. filed Sept. 15, 1909. Regulates voltage at busbars.

1,140,248. TIME-LIMIT-CONTROLLING DEVICE FOR ELECTRIC SWITCHES; G. A. Burnham, Saugus, Mass. App. filed Jan. 8, 1913. Embodies rotary motor.

1,140,249. TIME-LIMIT RELAY; G. A. Burnham, Saugus, Mass. App. filed Feb. 5, 1913. Has frictional means.

1,140,263. LOUD-SPEAKING TELEPHONE; W. Harrison, New York, N. Y. App. filed Aug. 21, 1905. Arc and vapor jet.

1,140,290. SIGNAL HORN; S. Scognamillo, New York, N. Y. App. filed Sept. 5, 1913. Ratchet construction for vibrating diaphragm.

1,140,310. PROCESS FOR RECOVERING ELEMENTAL SULPHUR FROM SULPHUR GASES; W. F. Lamoreaux and C. W. Renwick, Isabella, Tenn. App. filed June 21, 1913. Passes sulphur dioxide through bed of incandescent carbon.

1,140,322. END-CELL SWITCH; J. W. Achard, Philadelphia, Pa. App. filed March 9, 1911. Improved mounting for auxiliary resistance.

1,140,329. TELEPHONE SIGNALING SYSTEM; E. A. Mellinger, Chicago, Ill. App. filed May 9, 1913. Automatic or semi-automatic.

1,140,333. TYPEWRITER CARRIAGE-RETURN DEVICE; O. Brisbois, Chicago, Ill. App. filed Oct. 3, 1914. Attaches to ordinary machine and uses lighting current.